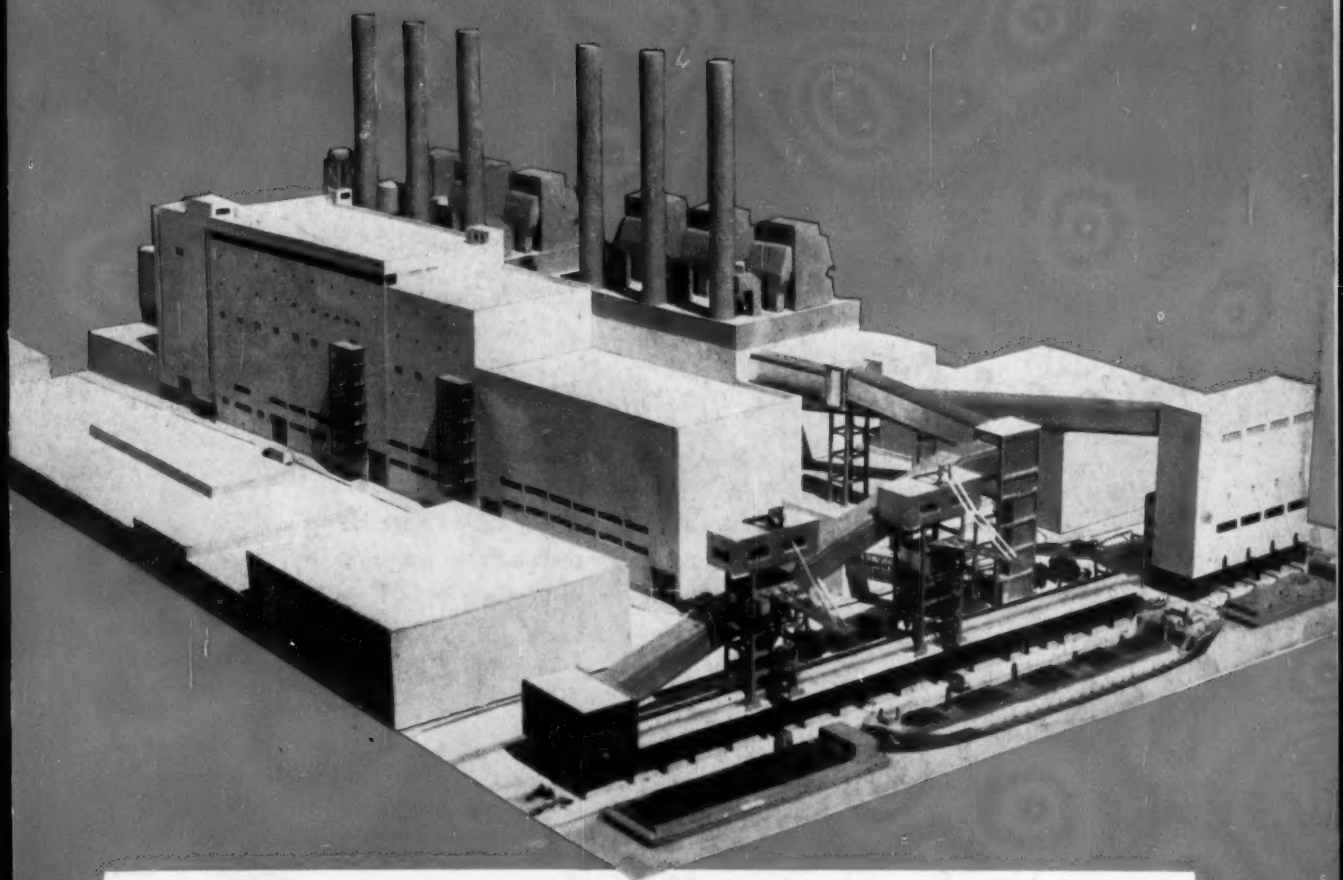
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES • A McGRAW-HILL PUBLICATION

Power

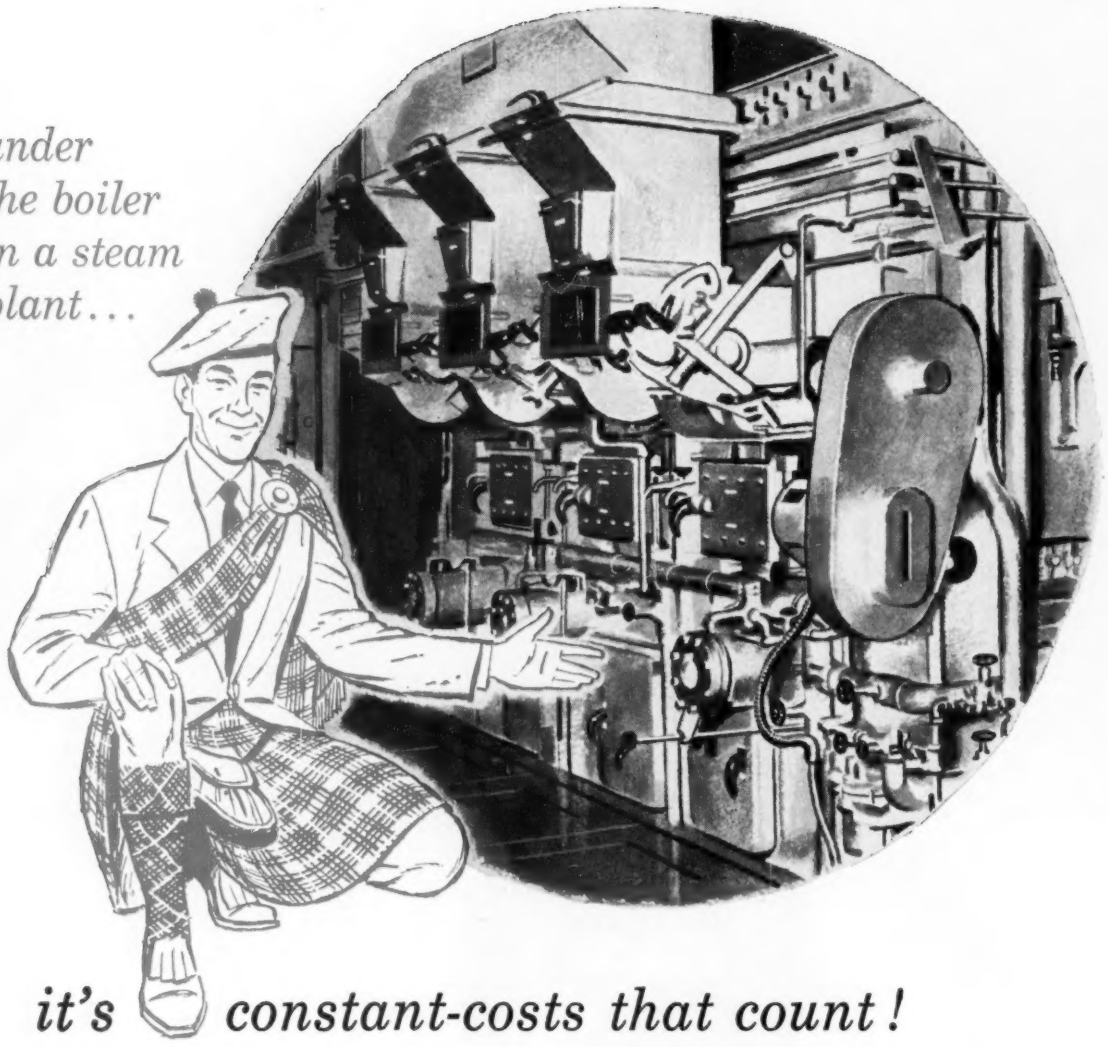
FEBRUARY 1956•50¢



Modernization Award Program

enter now for '56 ▸ p 84

under the boiler in a steam plant...



it's constant-costs that count!

Be Thrifty! Expensive boiler installations designed to burn fuels with limited futures is doubtful wisdom. The sensible alternative is to *bank on Bituminous!* Plotting your costs over the long run will prove efficiency and lowest cost in most cases. For, Bituminous reserves are unlimited—they're nearest to most manufacturers—coal technology improves burning equipment, efficiency and cost year by year.

Let our Coal Technical Service plot a constant-low-cost Bituminous coal for your needs. *Ask our man!*

COAL TRAFFIC DEPARTMENT, BALTIMORE & OHIO RAILROAD

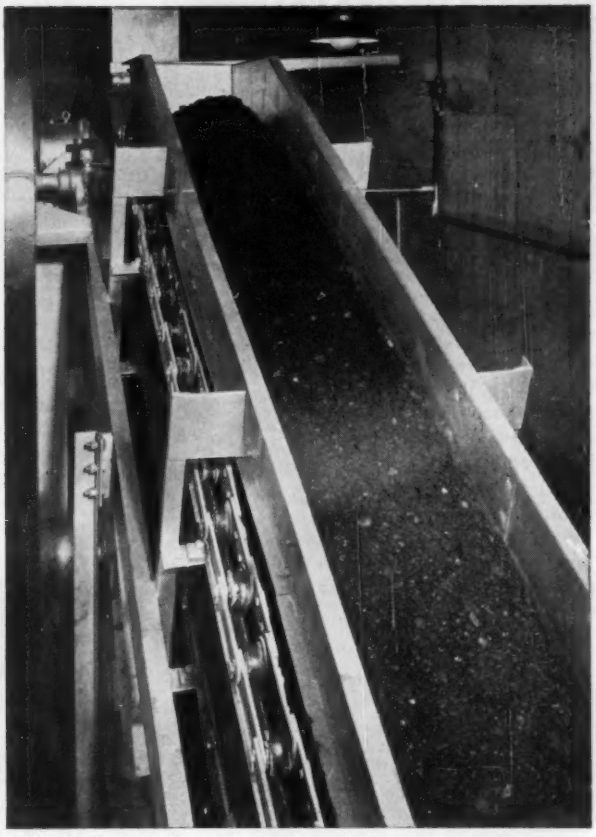
Baltimore 1, Maryland—Phone: LExington 9-0400

LINKING 13 GREAT STATES WITH THE NATION — B&O

BALTIMORE & OHIO RAILROAD

BITUMINOUS COALS FOR EVERY PURPOSE

At U. of Maryland steam plant, coal is dumped through screens to hopper. After sizing, Link-Belt bucket elevator fills coal bin via screw conveyor on roof. Undercut chute allows reclaiming of coal from bin to truck when desired.



Link-Belt 24-in. apron conveyor feeds vibrating screen. Oversize is sent to ring crusher, from which it rejoins fine coal on belt conveyor en route to Link-Belt bucket elevator. Egli & Gompf, Inc., Baltimore, were the consulting engineers.

How coal handling lessons learned in big power plants

benefit a small boiler house

LINK-BELT engineering and equipment is your assurance of lowest cost per ton handled

BACKGROUND gained in large installations has acquainted Link-Belt engineers with every kind of coal handling problem. And small plants, like the University of Maryland's, benefit from that experience and Link-Belt's complete line of equipment.

Link-Belt, working with you or your consultants, can offer you a coal handling system of *proved effectiveness* —maximum simplicity, with no improvised engineering or erection headaches. Link-Belt knows and makes what it takes to do the job right—be it feeders, crushers, unloading equipment or any kind or combination of conveyors.

Whether your plant is large or small a Link-Belt mechanized coal handling system can save you money. Get in touch with your nearest Link-Belt office today.

You'll be interested in Book 2410. Its 44 pages of photographs and drawings include many outstanding coal handling systems—both large and small.

LINK-BELT

COAL HANDLING EQUIPMENT

LINK-BELT COMPANY: Executive offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

13,784

DE LAVAL
OPPELLER PUMPS

last longer... cut maintenance costs

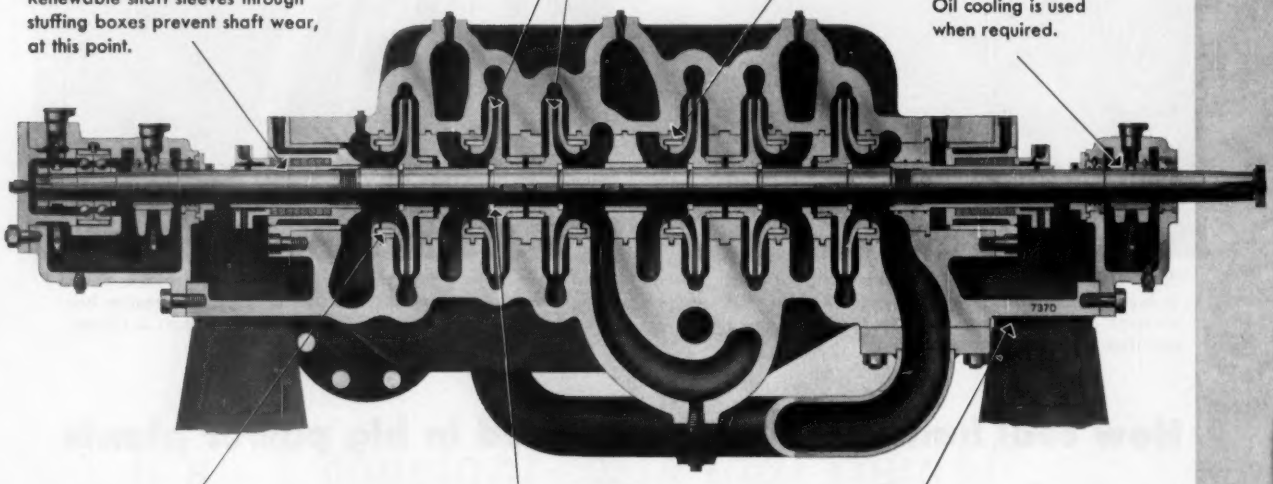
Stages are arranged to reduce differential pressures between stages. This insures permanent sealing at the casing-joint and at interstage diaphragms.

Pairs of back-to-back impellers balance axial thrust. One-purpose thrust bearing carries no radial load, maintains axial alignment.

Labyrinth wearing rings permit safe clearances and reduce wear.

All bearings are ring-oiled, sealed against contamination by water or dust. Oil cooling is used when required.

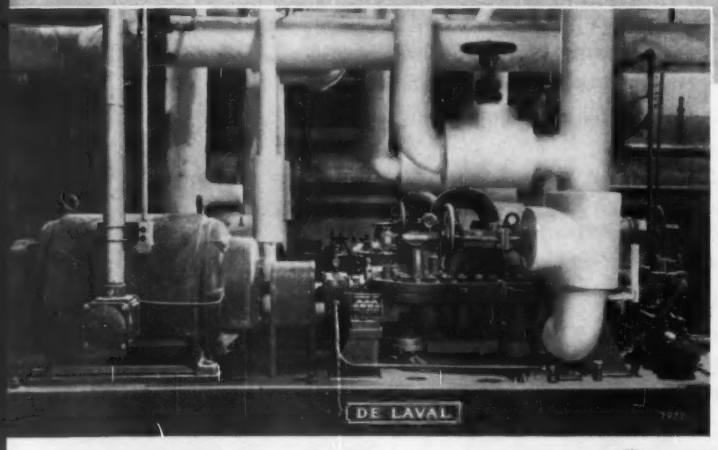
Renewable shaft sleeves through stuffing boxes prevent shaft wear, at this point.



Threaded impeller wearing rings make replacement easy without heating or damage to impellers.

Individual impeller mountings, with split locating rings, make interstage shaft sleeves unnecessary. Impellers can't shift with shaft expansion and contraction.

Casing support insures coupling alignment at any operating temperature.



Here are two De Laval 6-stage Oppeller Pumps used for boiler feed service in an industrial installation.

The design features above show clearly why De Laval Oppeller Pumps stay on the line longer and cost less to maintain. These pumps are used for boiler feed, hydraulic systems, descaling spray, mine dewatering, refinery oil pumping and similar services.

De Laval Oppeller Pumps are available in sizes from 2 to 4 inches and 2 to 8 stages; capacities to 1000 gpm, pressures to 1200 psig and temperatures to 3500F.

DE LAVAL *Oppeller Pumps*

DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

Power

FEBRUARY 1956 • VOLUME 100 NUMBER 2

ENGINEERING AND MANAGEMENT

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MODERNIZATION, this month's cover theme, is keyed to announcement of POWER's 3rd award program for successful plant modernization, p 84. Model shown is tomorrow's version of historic 74th St power plant, New York City Transit Authority. Plant, cited by POWER (Mid-September issue, 1955, p 61) is winding up first step of a $22.5-million modernization.

J G White Engineering Corp handled all engineering for this key plant, which supplies power for New York subways.

Next month . . .

Mechanical Seals, glamour girl of the large seal family, is subject of Associate Editor Steve Elonka's latest 24-p practical manual. In but a few years the mechanical seal has been fitted into a host of new industrial applications.

Starting with a simple analysis of the mechanical seal, Steve shoves off to cover types available, materials of construction, how to keep them working.

Producing taconite, an iron-bearing rock found in eastern end of Minnesota's Mesabi Range, requires about 100 kwhr per ton of concentrated ore. Lead article in March describes the big industrial power plant serving the process.

Packaged boiler, first of the watertube type, recently underwent initial field tests; came through nicely. Upcoming issue carries details of this new design.

. . . and future months

Centralized lube systems are too often designed with but single machines in mind. A 3-part series now shaping up will give you a fresh, practical slant.

February 1956 POWER Vol 100—No. 2

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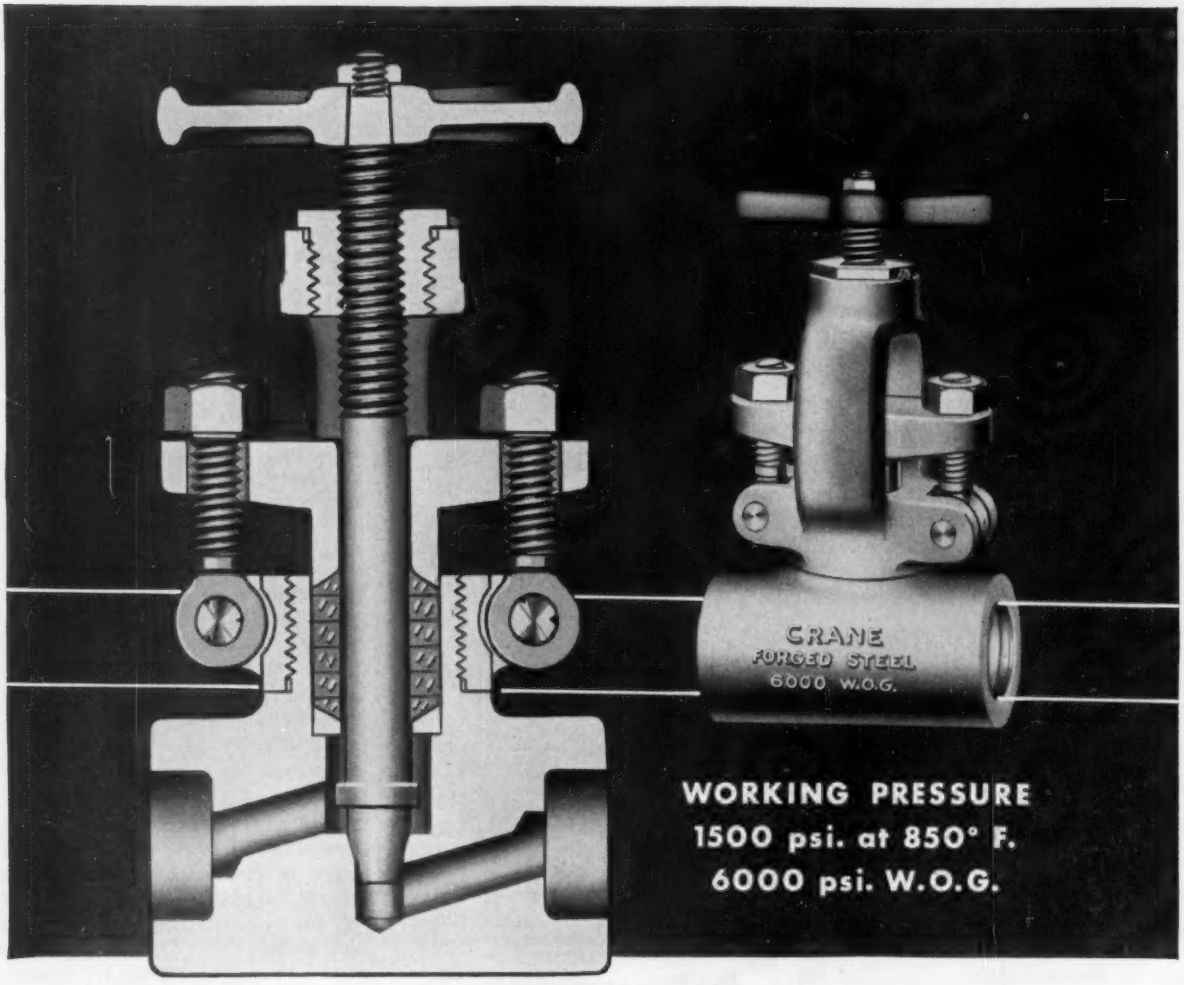
POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index.

Now Available



New Crane Forged Steel Instrument Valves

Been looking for an exceptionally rugged, compact, and low-priced stop valve for your small hydraulic or high-pressure, high-temperature instrument lines?

Crane has developed it—sizes ¼", ⅜" and ½", in both screwed and socket-welded patterns. It's the all-new Crane Forged Steel Instrument Valve, and you can specify it now for immediate delivery.

Will Handle Many Services

Note closely the over-all design and construction shown above of this new Crane valve. Oversized stuffing box—heavy-duty Crane Exelloy stem with integral disc—bolted gland—swinging gland eye bolts—outside screw and yoke construction—all add up to the high performance and low maintenance you want in a valve for your instrument panels, orifice meters, bypass and gauge lines, regulator leads, and other hydraulic and high pressure temperature lines.

Literature on Request

These rugged, low-cost stop valves are built for 1500 psi. at 850° and 6000 psi. W.O.G. Construction and materials are job-engineered by Crane experts—backed by a century of quality manufacturing, matchless experience. You'll want complete information on the all-new Crane Forged Steel Instrument Valves.

For literature contact your local Crane Representative, or write to address below.

CRANE VALVES & FITTINGS

PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

speaking of Power

Norman Peach, new Assistant Editor

Howard Kallen, Associate Editor: a step up the ladder

Preparing for tomorrow's editorial needs

Staying on top in technical journalism, as in any sizable business, requires a liberal staff of proficient people. In the power field, this is especially true in light of the growing technical demands on POWER readers across all industry. So a recent step in our staying-out-front editorial program was taken last October when Bob Bellas joined the staff as Assistant Editor (Jan 1956, p 87). Then on January 1, Howard Kallen was promoted from Assistant to Associate Editor. At the same time, Norman Peach linked with our editorial family as Assistant Editor. Norm joins us as an electrical editor to beef up POWER's expanding electrical responsibility to its readers. We now have the largest technical staff in our 74-year history.

Howard Kallen moved up to the associate rank after but two years as Assistant Editor. During that time Howie proved in many ways his ability to handle tough assignments. Typical: *New Profit Opportunities in the Power Services*, Dec 1954; *Modernization Award Program*, Mid-Sept 1955, to name but a few where he played a major role.

Kallen joined our staff after working with Westinghouse Steam Turbine Div, U.S. Army Ordnance Corp, Hyatt Div of General Motors and, finally, J G White Engineering Co. He's an honor graduate of Cornell in mechanical engineering, recently took his master's in ME nights at Brooklyn Polytechnic. Right now, he and wife Claire are learning to simultaneously master the problems of a new baby and a new home on Long Island.

Norman Peach joins us after a decade of on-the-job electrical experience in industrial plants, plus three years as a technical editor and writer. Field experience ran the gamut from trouble-shooting on motors, generators, controls, transformers to repairs on driven machinery, such as pumps, grinders, compressors, printing presses. Taking up his pen as a technical editor figures since, as a Brooklyn Polytechnic man, he was editor in chief of *The Polytechnite*. Peach comes to POWER with a well-rounded background. He will share electrical editorial responsibilities with Managing Editor Jim O'Connor.

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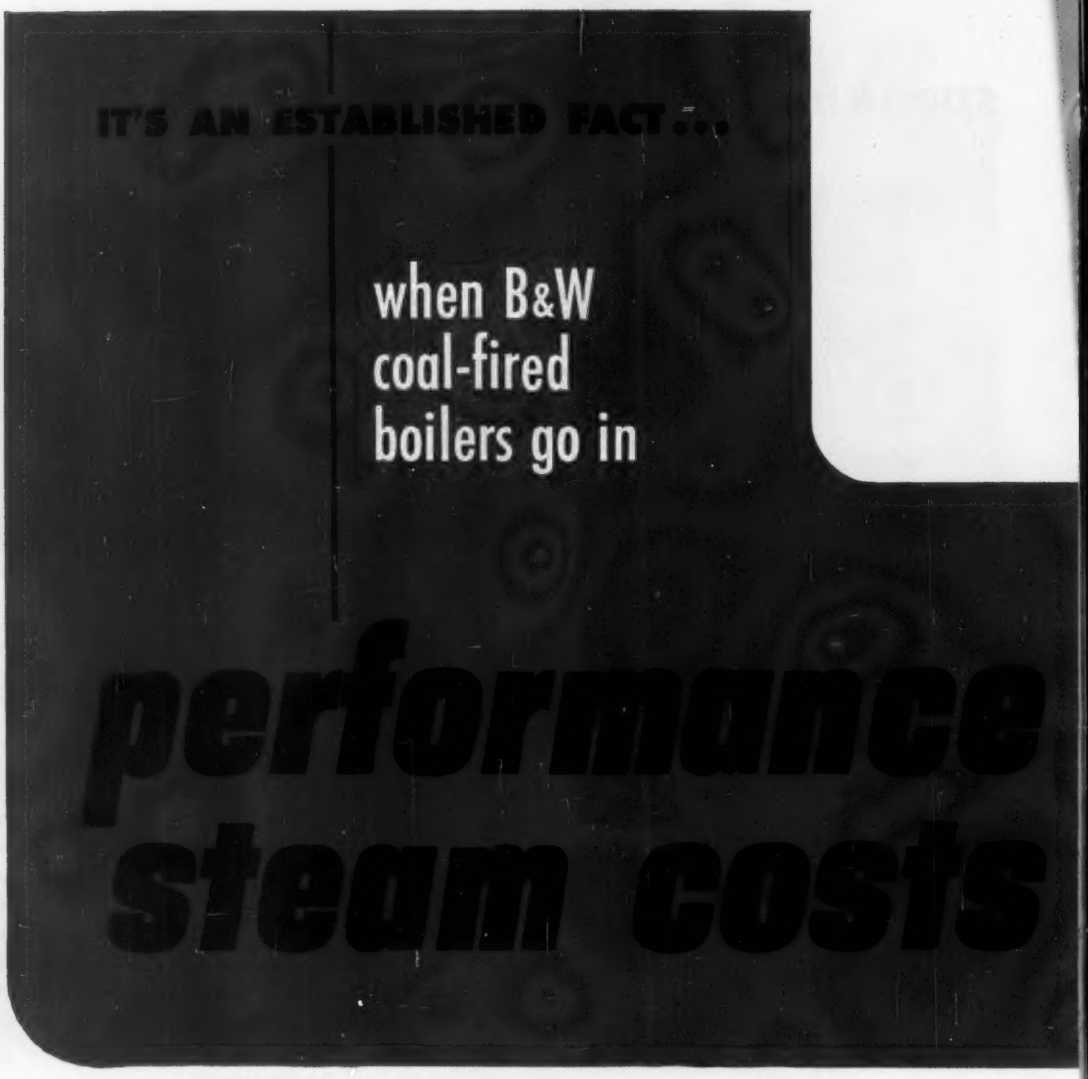


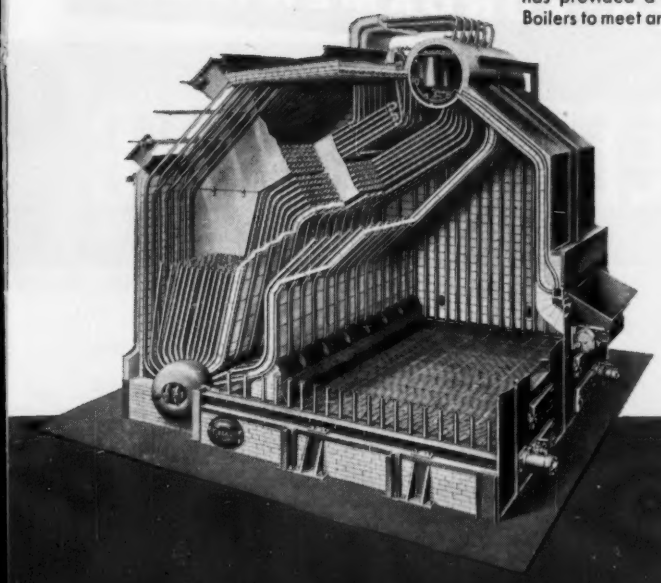
In plant after plant where B&W Boilers with modern auxiliaries have replaced other units, substantial overall savings have been reported as the combined result of space-saving, lower fuel costs through more complete fuel combustion, greater efficiency, less coal and ash handling, and elimination of fly-ash problems. Almost invariably with this reduction in fuel, operating labor and maintenance costs goes an increase in steam capacity. And where demand varies widely, B&W Units provide a constant and reliable steam supply with quick response to rapid and heavy load swings.

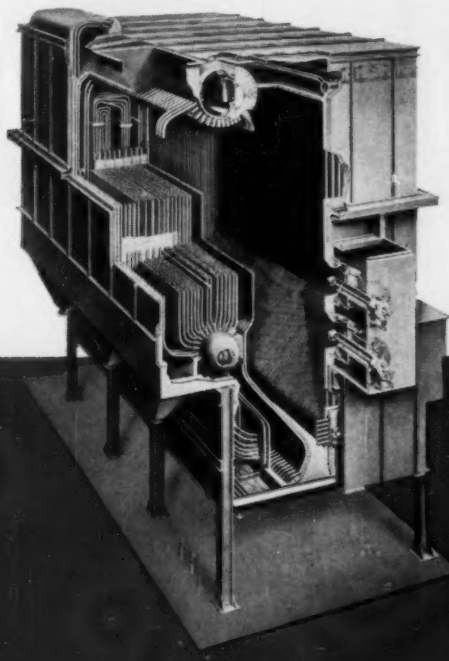
A leading choice of industrial users for a broad variety of applications, B&W Integral-Furnace Boilers with steam capacities to 200,000 lb per hr have been providing maximum capacity in small space, high fuel economy, smokeless combustion and fast steaming since their introduction in 1933. The well over 200,000,000 lb per hr total capacity now in service or on order, representing all types and firing methods, is the strongest possible endorsement of the reliability and economy of these units.

The B&W Stirling Two-Drum Boiler is in service for capacities to 460,000 lb of steam per hr. Coal-fired units of this type have been especially successful in industrial service at high ratings and with wide load variations. Spacing of tubes in boiler bank and single-pass gas flow contribute to excellence in steaming and freedom from ash fouling.

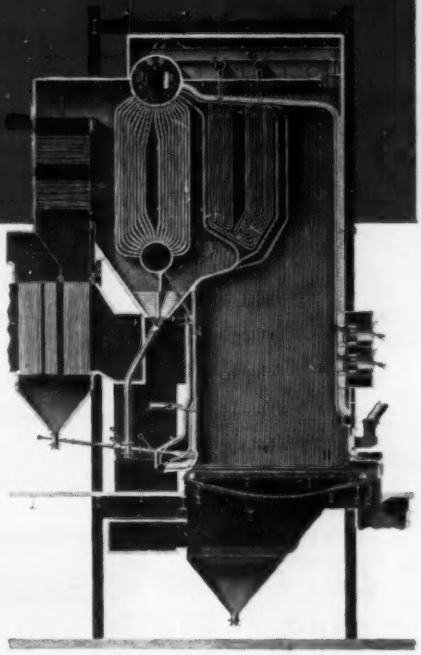
If space-saving is an important factor . . . If your fuel and maintenance costs are excessive . . . If fly-ash is becoming more and more of a problem . . . there's a cost-saving B&W Boiler to suit your precise needs. Check with B&W before planning your next installation. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

From an FF installation for as low as 4600 lb per hr to the FH's 200,000 lb per hr, and in between, B&W has provided a choice of coal-fired Integral-Furnace Boilers to meet an unusual range of steam requirements.





goes up go down



A large number of B&W Stirling 2-Drum Boilers in capacities to 460,000 lb per hr are providing exceptionally satisfactory service in a variety of industrial installations.

Typical comments quoted below indicate the performance pattern set by B&W coal-fired boilers in service in industrial plants of all types across the country.

"Boiler response is excellent . . . steam pressure is steady and continuous . . . previously serious fly-ash problem has been substantially reduced." —*Chemical Plant Chief Engineer*

". . . I am confident that we could not have made a wiser choice . . ." —*Processing Company Plant Engineer*

". . . benefits include reduction of labor in coal and ash handling, a cleaner boiler room, adequate smoke control and improved performance records . . ."
—*Tobacco Company Chief Engineer*

". . . and it's saving us 20 tons of coal every day."
—*Paper Mill Superintendent*

"We're not selling B&W Boilers, but we can't recommend them too highly . . ." —*Processing Company Plant Engineer*

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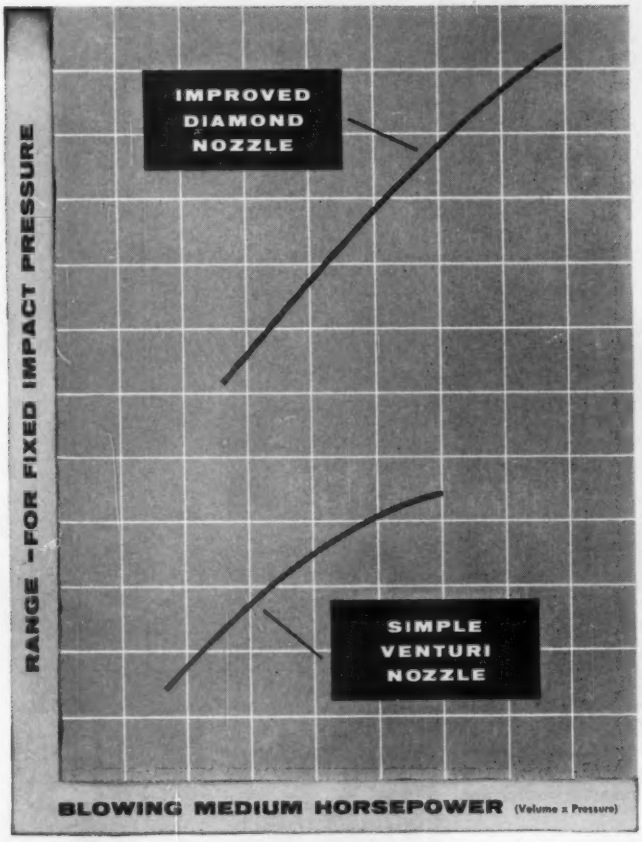
BABCOCK & WILCOX
BOILER DIVISION

GETTING BACK TO FUNDAMENTALS:

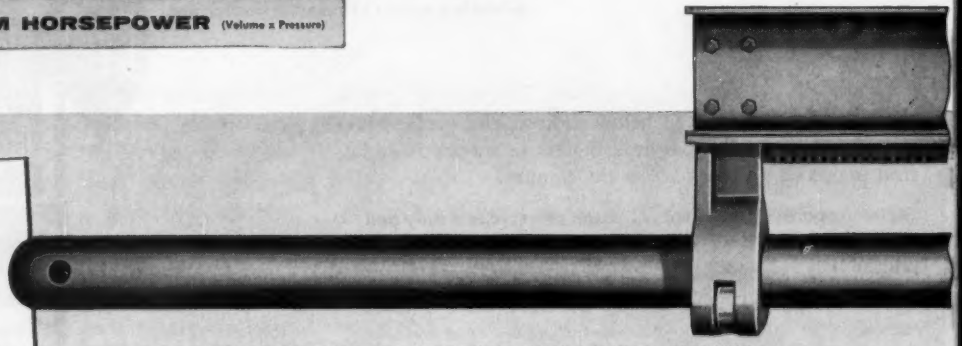
Efficient BOILER CLEANING


IMPROVED DIAMOND NOZZLE
SIMPLE VENTURI NOZZLE
RANGE - FOR FIXED IMPACT PRESSURE
BLOWING MEDIUM HORSEPOWER (Volume x Pressure)

The blower nozzle has the job of converting steam or air pressure into velocity which, in turn, produces impact pressure at the surface to be cleaned. Effective cleaning depends on this impact pressure. A well-designed nozzle will convert much more efficiently . . . doing a better cleaning job with less steam or air.

During the past several years Diamond has conducted intensive research into nozzle design to find the ultimate in efficiency. (More than 50 designs were tested.) It was soon found that nozzle design responds to perfection of detail. Among the details studied were: (1) divergence angle of nozzle, (2) inlet radius as a function of throat diameter, (3) length-diameter ratio of nozzle, (4) area ratio of lance to nozzle throat, and (5) nozzle approach conditions. A product of this research is our new "Type A" Nozzle for Model IK Blowers. The curves at the left show how much more efficient it is than the simple venturi nozzle. The result is improved cleaning at substantially lower energy cost.

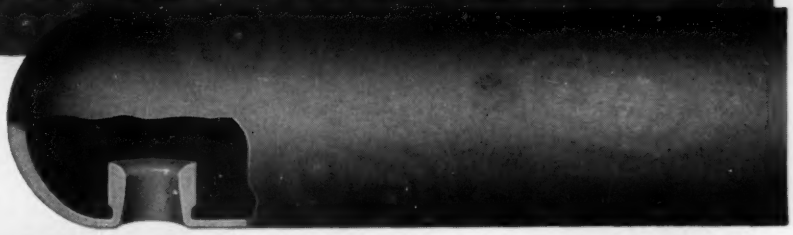
YOU CLEAN BOILERS *BETTER* and at *LOWER COST* with DIAMOND BLOWERS



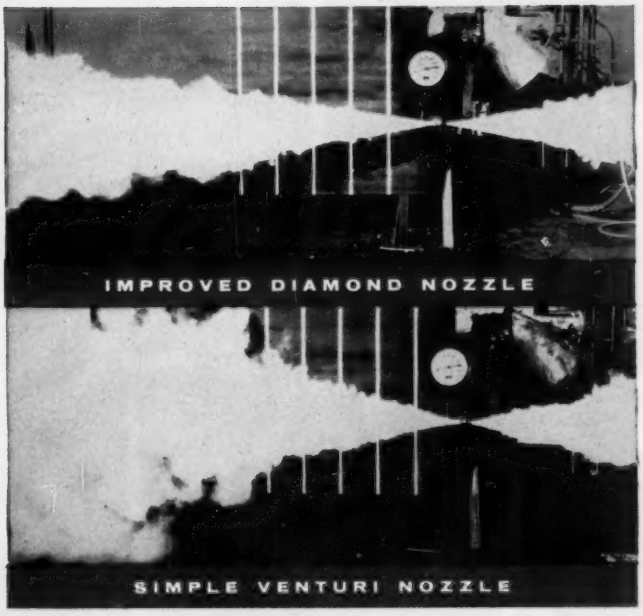
DIAMOND MODEL IK LONG RETRACTING BLOWER

A SINGLE motor (air or electric) both rotates and propels the long lance tube through a simple and rugged gear system. Only one set of motor elements, one set of control elements and one set of power supply facilities to operate and maintain. Flow control of blowing medium (steam or air) is automatic, positive and accurate by means of a simple, mechanically operated valve. This valve is poppet type and has adjustable pressure control. The improved nozzle design coupled with the close helical cleaning pattern assures maximum effectiveness for each blower operating cycle. For additional advantages, write for Bulletin 1080U.

Starts at the BLOWER NOZZLE

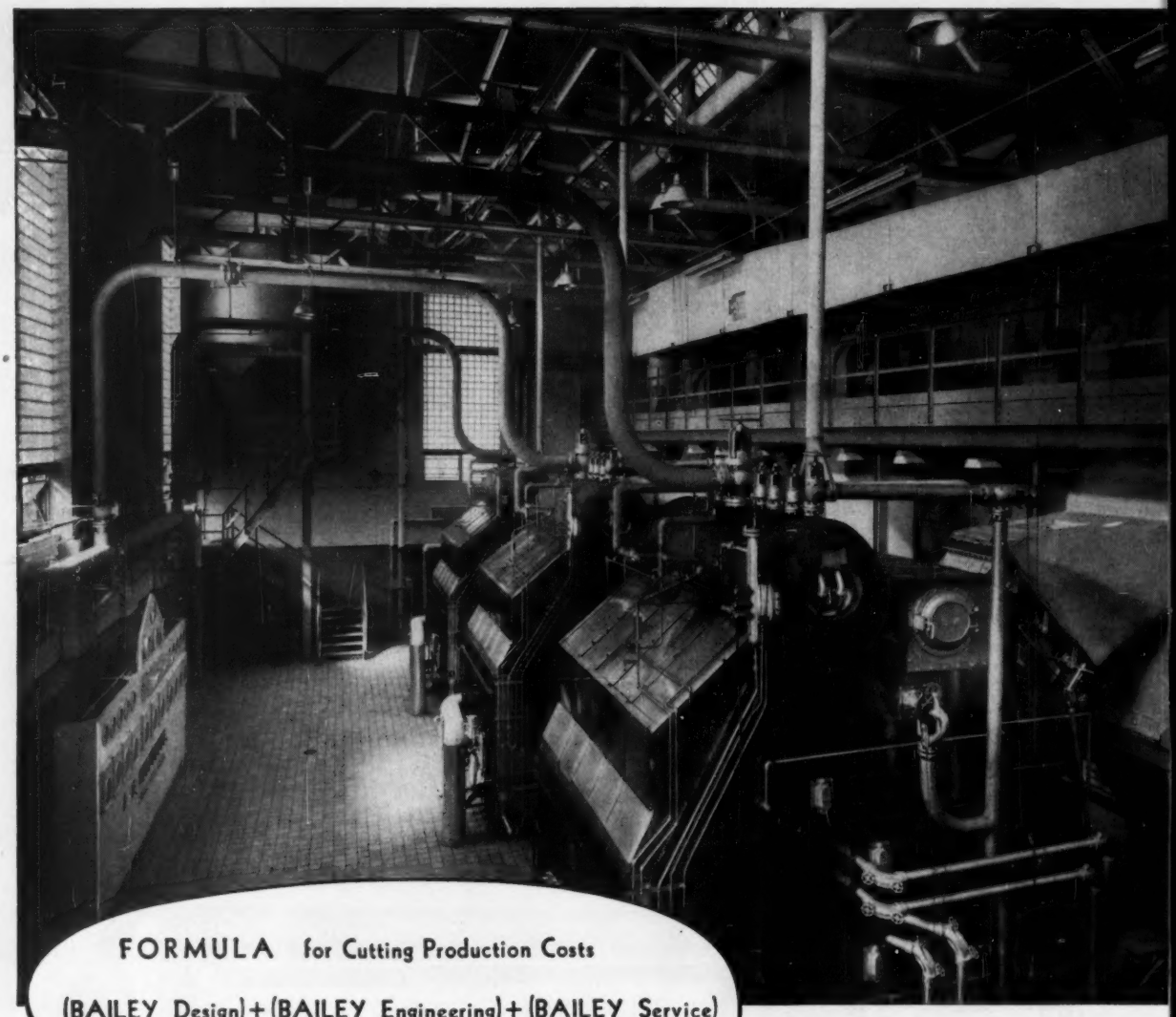


Photograph of section through Diamond "Type A" Nozzle.



The two photographs at the left show the Improved Diamond Nozzle and the simple venturi nozzle under identical test conditions. These tests proved that the effective range of the new Diamond nozzle is substantially greater. Also that at the same range, the impact pressure of the Improved Diamond Nozzle is much higher than for the simple nozzle. For equal cleaning ability, the higher efficiency of the new Diamond nozzle requires a much lower blowing medium pressure.

How to



FORMULA for Cutting Production Costs

(BAILEY Design) + (BAILEY Engineering) + (BAILEY Service)

= GREATER SAVINGS PER FUEL DOLLAR

In the Nela Park central heating plant of General Electric Company, Bailey Meter Control insures efficient use of fuel. It enables operators to run these 18,000 lb per hour 125 psi spreader stoker-fired boilers under optimum conditions at all times.

Save Fuel

★ The productive energy produced by a unit of fuel depends on the way you put it to work in your boiler. How much heat energy you actually get depends upon the performance of your steam plant equipment.

That's where Bailey Controls can help. With a Bailey-engineered control system, you can count on a higher output of available energy per unit of fuel. Here's why:

1. Complete Range of Equipment—fully co-ordinated

You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, as might be the case if he had only a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control *systems*.

2. Engineering Service—backed by experience

No other manufacturer of instruments and controls can offer as broad an experience based on succesful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you

Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum travel-time and expense.

For greater fuel savings, less outage, and safer working conditions you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record.

A-117-2

BAILEY
METER COMPANY
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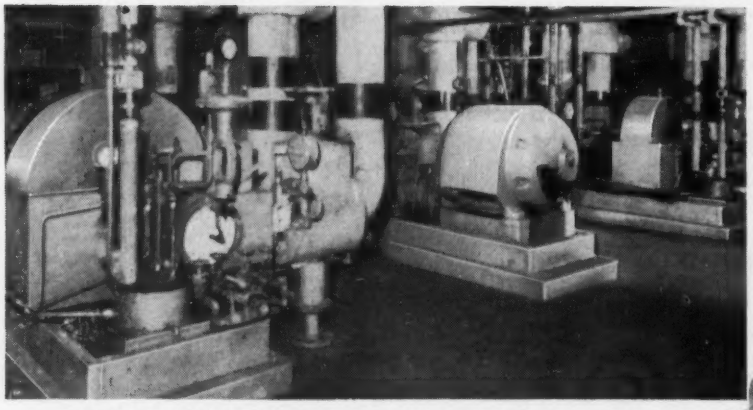
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

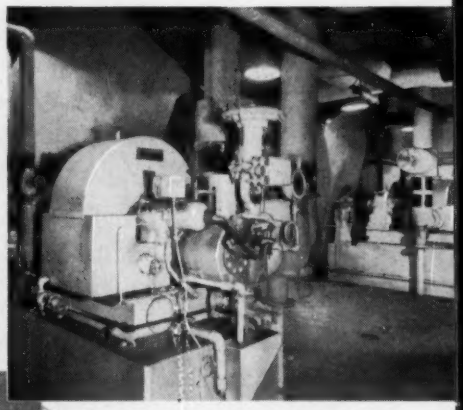
BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS

Steam or Electric

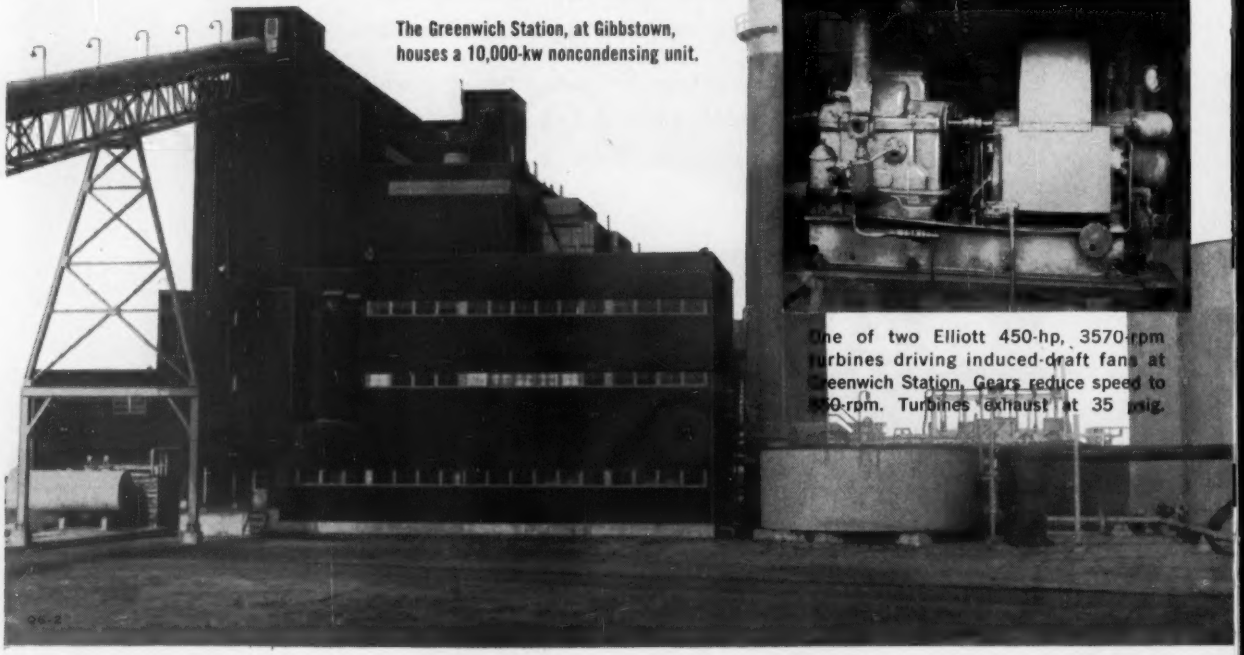
Two Atlantic City Electric Company stations show contrasting use with Elliott Turbines and Motors



Two Elliott 406-hp, 3550-rpm turbines driving boiler-feed pumps in the Greenwich Station. Turbines take steam at 175 psig, 570 F, and exhaust at 35-psig back pressure. Turbines are suitable for future 700 F operation.



Two Elliott 203-hp, geared turbines driving forced-draft fans at Greenwich Station. Turbines operate at 3570 rpm, which speed is reduced to 1250 rpm on the fans.

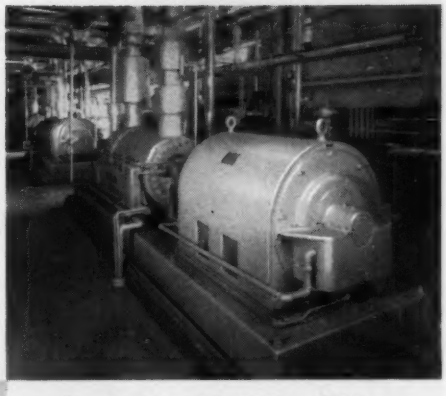


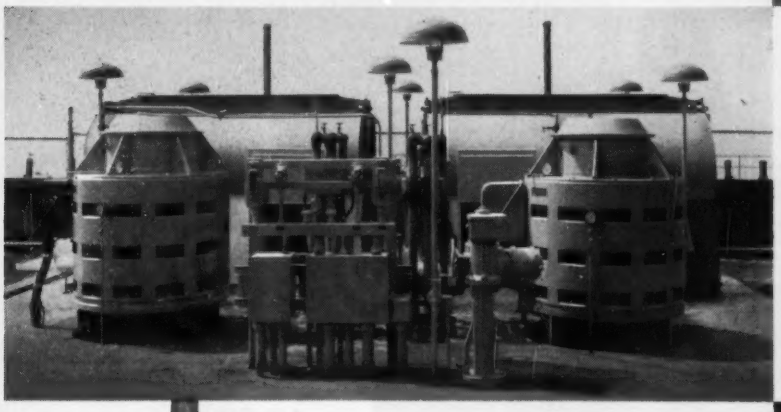
The Greenwich Station, at Gibbstown, houses a 10,000-kw noncondensing unit.

One of two Elliott 450-hp, 3570-rpm turbines driving induced-draft fans at Greenwich Station. Gears reduce speed to 850-rpm. Turbines exhaust at 35 psig.

driven auxiliaries?

● Both the Greenwich Station at Gibbstown, N. J., and the Deepwater Station near Penns Grove, N. J., furnish process steam for industrial use. The Greenwich Station operates a 10,000 kw, 175 psig back-pressure noncondensing unit and so makes use of steam auxiliary drives. The Deepwater Station, however, houses about 185,000 kw of capacity in condensing units in addition to back-pressure turbines for industrial steam supply. Hence it uses the conventional electric motor drive for auxiliaries. In both cases, Elliott machines — mechanical drive turbines and electric motors — are on the job driving boiler-feed pumps, condensate pumps, forced-draft and induced-draft fans.

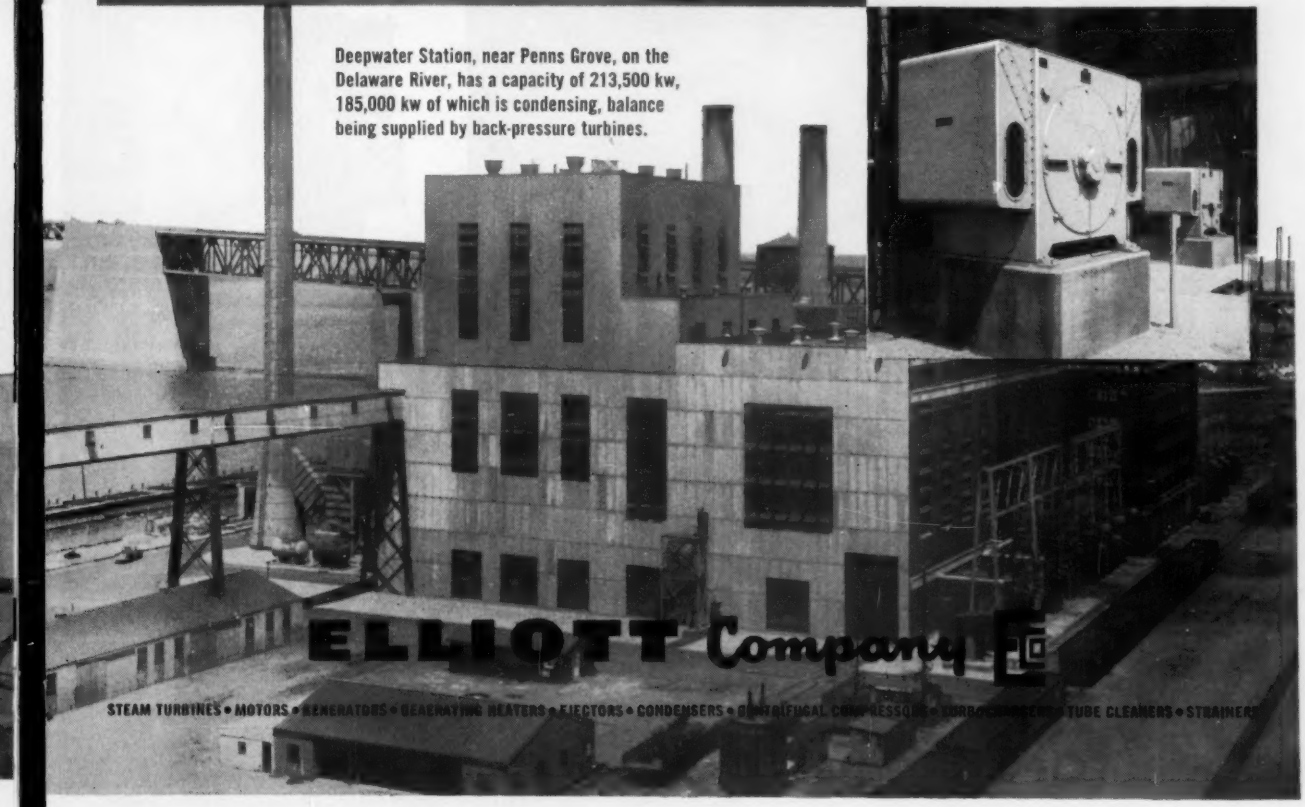




Above are three Elliott 900-hp, 3600-rpm squirrel-cage induction motors driving boiler-feed pumps in the Deepwater Station.

At left are two Elliott 300-hp, 514-rpm vertical outdoor weather-protected motors driving circulating pumps at Deepwater.

Below are outdoor weather-protected motors driving draft fans at Deepwater. In foreground is a 1500-hp, 720-rpm motor driving an i-d fan. The other, a 500-hp, 1200-rpm motor, drives an f-d fan.

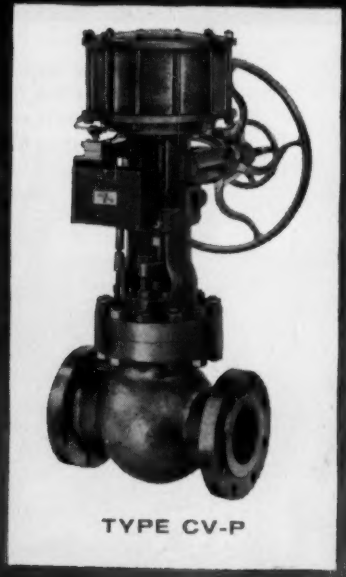


Deepwater Station, near Penns Grove, on the Delaware River, has a capacity of 213,500 kw, 185,000 kw of which is condensing, balance being supplied by back-pressure turbines.

ELLIOTT Company

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

TYPE CV-D



TYPE CV-P

COPES VULCAN

COPES-VULCAN

Announcing... the new

COPES-VULCAN VALVES

. . . with new versatility
. . . with new broader application
. . . with new attractive appearance

THE NEW HIGH-QUALITY Copes-Vulcan valves offer simplified designs and can handle any application at unlimited pressures for pipe sizes up to 16-inch. They have all the rugged dependability typical of Copes-Vulcan products. As always, they will be custom-designed with ports exactly suited to individual operating conditions.

NEW VERSATILITY IN DIAPHRAGM-TYPE, CV-D

You can now assure yourself of unsurpassed Copes-Vulcan quality in valves for operation at unlimited pressures. You may have either direct or reverse action. Rangeability is high.

Optional features include: Cooling fins and lubricator for stuffing box that will maintain low friction over a longer packing life . . . a top or side-mounted hand wheel to permit emergency operation . . . Auto-lock to hold the valve in its last position, should control air fail.

NEW SIMPLICITY IN PISTON-TYPE, CV-P

This is the high-duty Copes-Vulcan valve—simplified in appearance and design, but retaining the superb operating characteristics that have made former Copes valves so outstanding.

It is the new Type CV-P, for application where you need the ultimate in valve-operating force . . . more than is available from a diaphragm . . . where you need extremely precise positioning . . . where you want the finest valve that money can buy.

You can get this new Type CV-P Valve for pipe sizes up to 16-inch, for unlimited pressures.

Rangeability is high. Response can be characterized to meet your operating requirements.

Write, or get in touch with your Copes-Vulcan man for complete information.

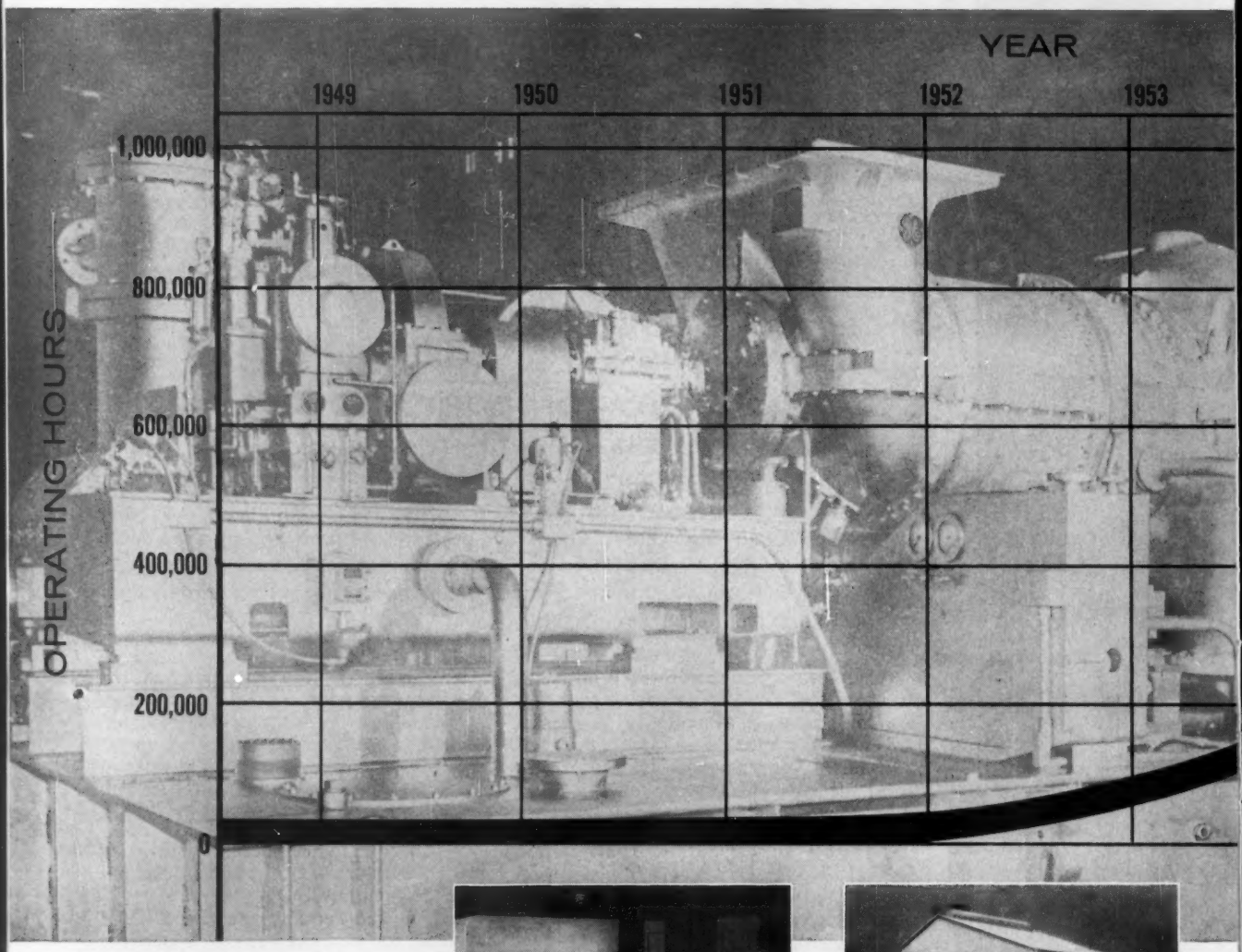
COPES-VULCAN DIVISION

BLAW-KNOX COMPANY

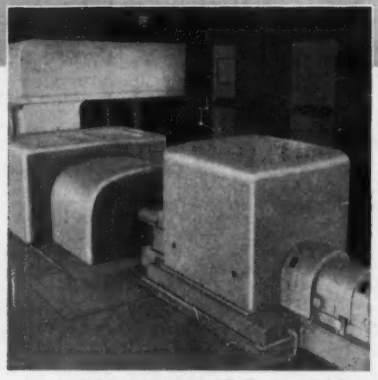
Erie 4, Pennsylvania

REDUCING VALVES

General Electric Gas top 1,000,000 hours



The Million Hours of operating time shown on the graph above have been logged in applications similar to those shown at right →

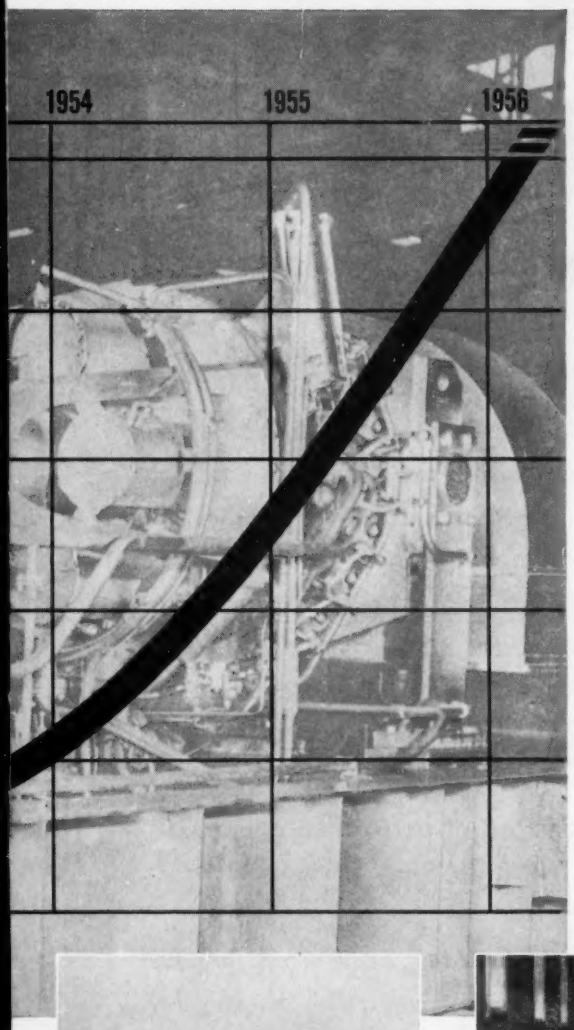


IN POWER GENERATION, G-E gas turbines are continuing to prove an economical addition to steam turbine-generator systems. In one installation, the addition of a gas turbine to the steam station cycle improved the heat rate 15%. Naturally, improvements will depend on existing station conditions.

IN GAS PIPELINE PUMPING, G-E units lower pumping costs. G-E gas turbines are ideal for these installations as they go on the line in less than 15 minutes, can operate virtually unattended, use gas from pipeline as fuel. Little or no water, only a small amount of lubricating oil are required.

Turbines of service

Now, new ratings from 4750 to 28,400 kw promise even wider use of G-E units in electric utility power generation



With an impressive 1,000,000 hours to their credit in varied applications, General Electric gas turbines are now becoming an increasingly important consideration in the selection of power plants for utility power generation. As versatile, low-cost, self-contained power makers, they offer particularly attractive opportunities for use as peak-load and standby units—as well as in small and medium base-load plants, end-of-line generating installations and combined gas turbine-steam turbine cycles.

LOW OPERATING COSTS of General Electric gas turbines have been proved through 114 machine years of service in more than 100 industrial and utility installations. Suitable for remote, unattended operation and containing few wearing parts, a G-E gas turbine power plant requires very little maintenance. According to one user, maintenance costs have amounted to only 0.2 mills per kilowatt hour. In addition, installation cost per kilowatt is less for a General Electric gas turbine-generator station than for other complete power plants of comparable size. Gas turbines up to 9200 kw are shipped and installed on an integral base requiring only a small area and a simple foundation.

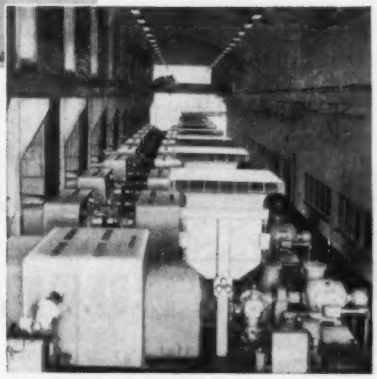
NEW RATINGS FROM 4750 to 28,400 kw promise to open up a broader field of application where the unique features of the gas turbine can bring even greater economies.

Your nearest Apparatus Sales Office will be glad to consult with your engineers and show how the special advantages of a G-E gas turbine can be applied to your operation. Or write Section 261-18C, General Electric Co., Schenectady 5, N. Y.

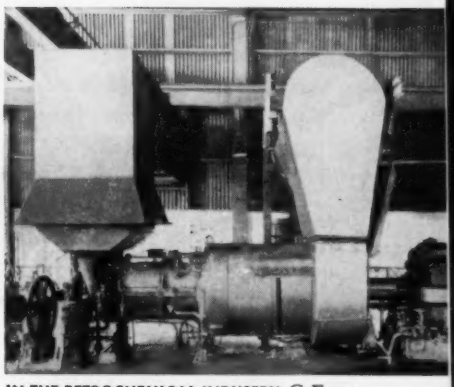
Progress Is Our Most Important Product

GENERAL ELECTRIC

IN RAILROADING, G-E gas turbines have proved their dependability under severe operating conditions. Utilizing low-cost residual fuels, units pack tremendous power for their size and weight. A new G-E 8500 hp gas turbine-electric locomotive can do the work of 5 diesel locomotives.



IN PETROLEUM PRODUCTION, G-E units are used in oil-field pressure maintenance. Driving centrifugal compressors, G-E gas turbines re-inject high pressure gas to oil fields . . . thus increasing petroleum yield. Simplicity of installation, ability to operate with little attention are prime advantages.



IN THE PETROCHEMICAL INDUSTRY, G-E gas turbine is relied upon for continuous 24-hour compressor service. In addition, significant savings are realized by using the hot exhaust gas in heat recovery boiler to make process steam—a good example of the versatility of gas turbine operation.

NOW!

"BUFFALO"
VARIABLE INLET DRAFT CONTROL
—WITH FIXED VANE PERFORMANCE AT WIDE OPEN POSITION

The variable inlet vanes of this "Buffalo" Forced Draft Fan are cantilevered into the fan's inlet shroud, with the operating linkage behind the shroud and entirely out of the air stream. This provides clear and unobstructed air flow. Further, the variable vanes are curved to the same degree as the well-known "Buffalo" fixed vanes, for which the fan is designed. Because "Buffalo" Fans are designed for fixed vanes the use of variable vanes *results in less than one percent reduction in rated capacity.* Construction is accessible and trouble-free. The entire lever and control ring assembly is permanently aligned for smooth operation with no backlash.

Here is one more illustration of the "Q" Factor* of performance and satisfaction that is yours when you specify "Buffalo" for mechanical draft.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

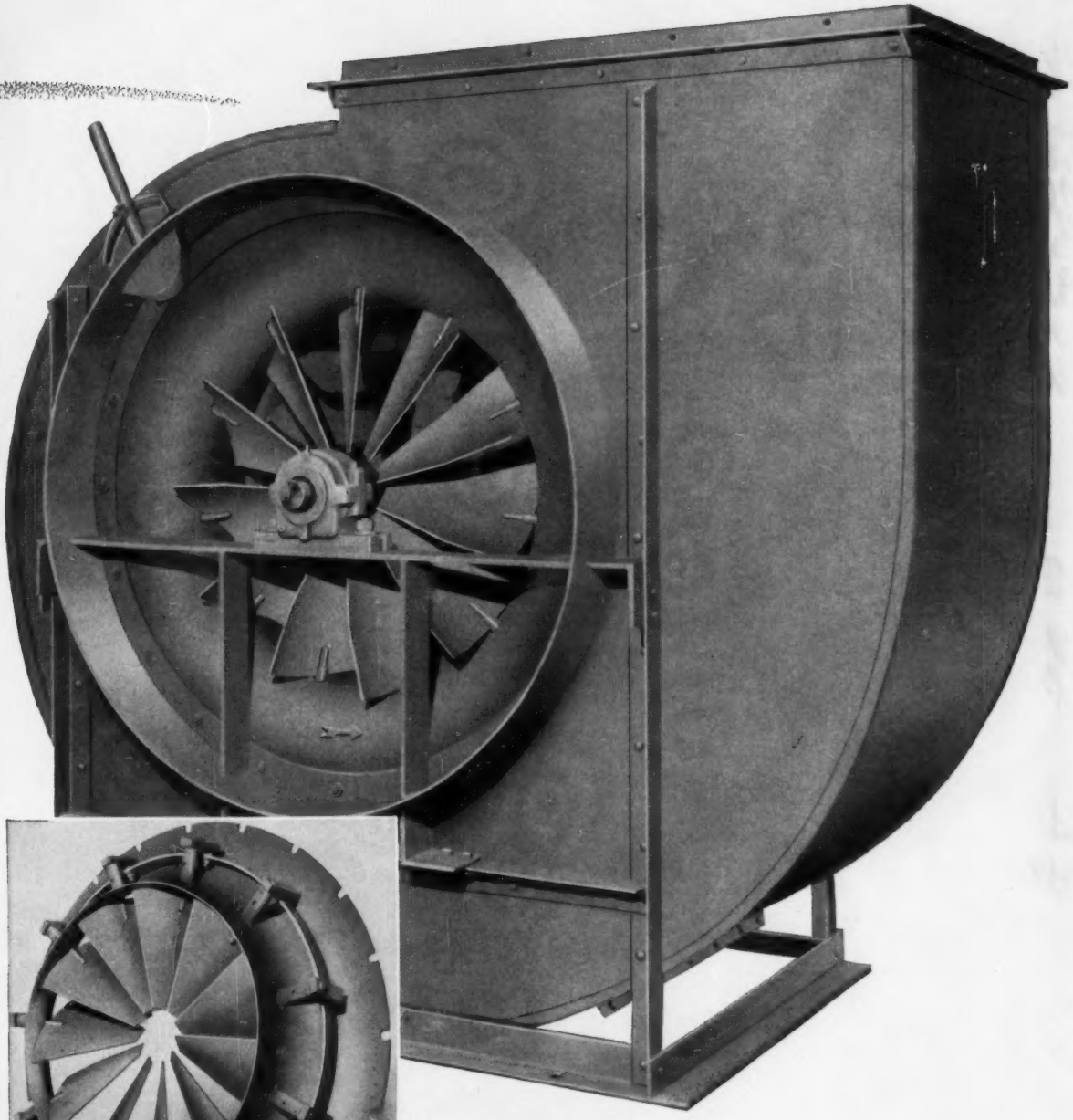
"Buffalo"

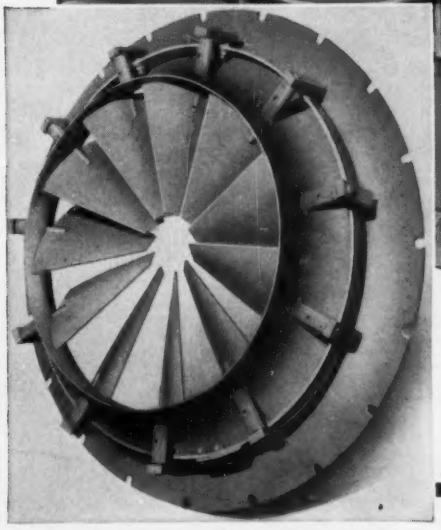
BUFFALO FORGE

BUFFALO,

Canadian Blower & Forge Co., Ltd.,

VENTILATING AIR CLEANING AIR TEMPERING PRESSURE BLOWING





Note how cantilevered arrangement of "Buffalo" Variable Inlet Vanes permits unobstructed air flow. Write for Bulletin F-1510 for full details on this smooth draft control with high performance.

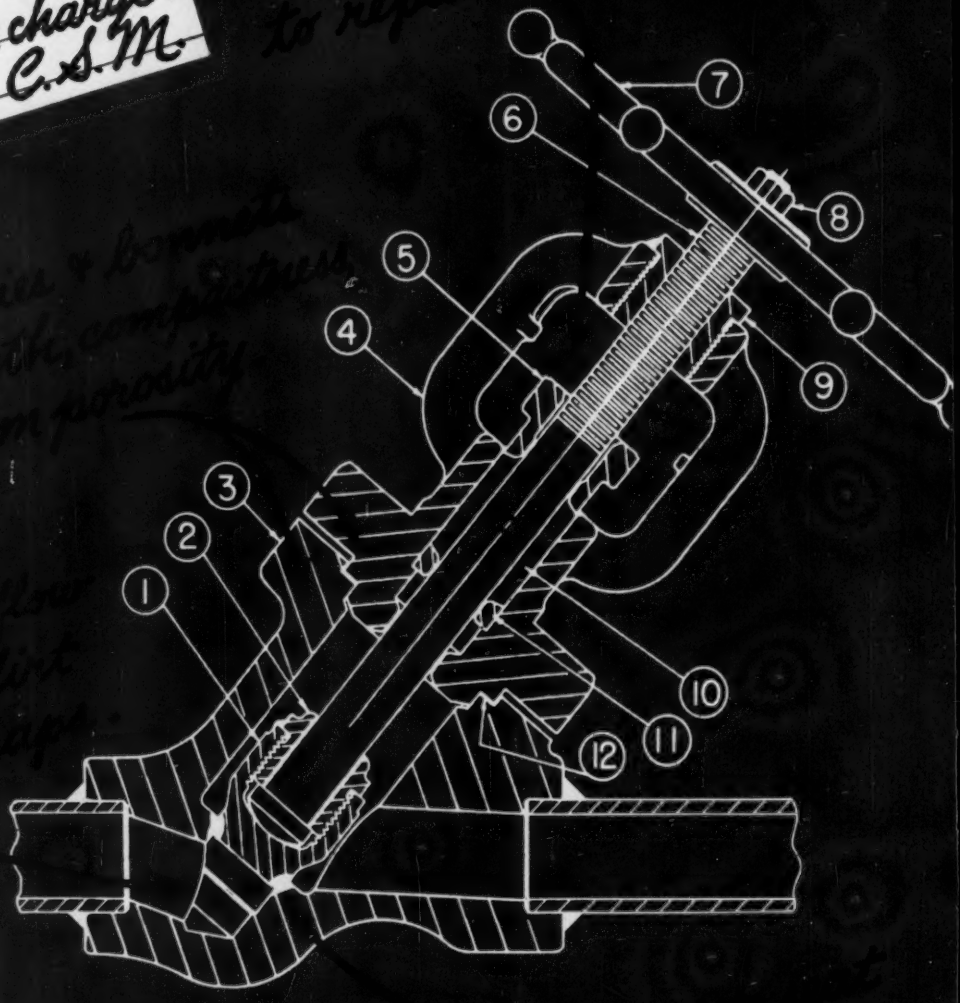
COMPANY

NEW YORK

Kitchener, Ontario

INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING

R. G. R.–
All boilermakers
Approve Edward
Blow-Off Valves–
will supply them
without extra charge.
C. S. M.



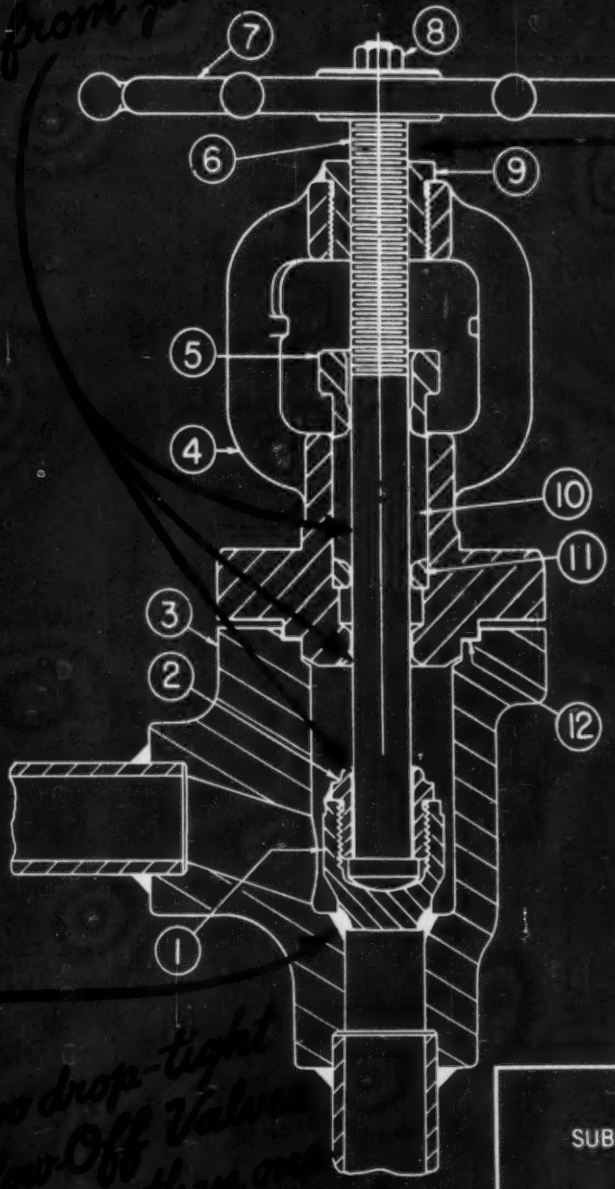
LIST OF MATERIAL
QUANTITIES ARE FOR 1 STRAIGHTWAY OR 1 ANGLE VALVE
WHERE A.S.T.M. SPECIFICATIONS ARE INDICATED THE LATEST REVISION APPLIES

PIECE NO.	NAME OF PIECE	NO. REQ'D	MATERIAL	SPECIFICATIONS	EDWARD MS. NO.
1	DISK	1	FORGED ALLOY STEEL WITH	A.S.T.M. A182 GRADE F11 STELLITED SEATING FACE	227 483
2	DISK NUT	1	STEEL	A.I.S.I. G1120	123
3	BODY	1	FORGED STEEL WITH	A.S.T.M. A105 GRADE II STELLITED SEATING FACE	111 483
4	BONNET	1	FORGED STEEL	A.S.T.M. A105 GRADE II	111
5	GLAND	1	MALLEABLE IRON	A.S.T.M. A220, GRADE 53004	324
6	STEM	1	EVALLOY	A.I.S.I. GRADE 416	261
7	HANDWHEEL	1	MALLEABLE IRON	A.S.T.M. A47 GRADE 32510	322
8	STEM NUT	1	STEEL	A.S.T.M. A194 - CLASS 1	124
9	YOKE BUSHING	1	BRONZE	A.S.T.M. B62	412
10	PACKING RINGS		EVALPAK	HIGH TEMPERATURE PACKING	501
11	JUNK RING	1	STEEL - EVALIZED	A.I.S.I. G1120	123
12	BONNET GASKET	1	IRONKOTE	ARMCO IRON 90 BHN MAX	505
13	GLAND BOLT WASHER	2	STEEL		
14	GLAND BOLT	2	FORGED STEEL EVALIZED	A.S.T.M. A105 GRADE II	111
15	GLAND BOLT NUT	2	STEEL - EVALIZED	A.S.T.M. A194 - CLASS O	125
16	TAP END STUD	4	ALLOY STEEL	A.S.T.M. A193 GRADE B7	208
17	BONNET STUD NUT	4	STEEL	A.S.T.M. A194 - CLASS 1	124

ROCKWELL-BUILT
EDWARD STEEL VALVES

Deep packing chamber-dependable backseat assure freedom from packing problems.

Edward Acme form threads are easy to operate at all pressures.



Gadgety designs with internal packing and sliding contacts are potential headaches.

Let's Request Edward Blow-Off Valves

Two drop-tight Blow-Off Valves are better than one. It permits repair without shutdown - gives piping flexibility - parts are

EDWARD VALVES, INC.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO.

EAST CHICAGO, INDIANA

1500 lb. FORGED STEEL BLOW-OFF VALVES

DRAWN Kalpatti		DRAWING Nº
CHK'D. S Rust		AE-3664-1
APPD. De Mathus	DATE 8-27-53	

Edward builds Globe and Angle Stop, Non-Return, Stop-Check, Check, Gate, Blow-Off, Mudline, Relief, Hydraulic, Instrument, Gage, and Special Valves and Strainers.

Paper Mills Choose

WA-Series STEAM TURBINE GENERATOR UNITS

for

Produce Economical Plant Power as By-Product from Process Steam

At John Strange Paper Company

MENASHA, WISCONSIN

5000-kw WA-Series unit produces power at 2400/4160 volts as a by-product of 150,000 lb per hour of process steam. Steam conditions at the turbine are 700 psig, 825 F, with 50 psig exhaust.

ALLIS-

Allis-Chalmers Units Power Generation

The paper industry is a good example of many industries across the country that are choosing modern Allis-Chalmers WA-Series steam turbine generating units for plant power generation. Many installations are already operating in NEMA ratings from 2000 to 7500 kw. Recently, the line was extended to 16,500 kw in AIEE-ASME preferred ratings.

WA-Series units are available for condensing or non-condensing service, with or without automatic extraction, providing the kind of advanced design that power producers want. Basic engineering features include labyrinth steam seals throughout, removable external glands, high chrome alloy steel buckets, and a time-proved governing system.

Engineered to Save Installation Costs

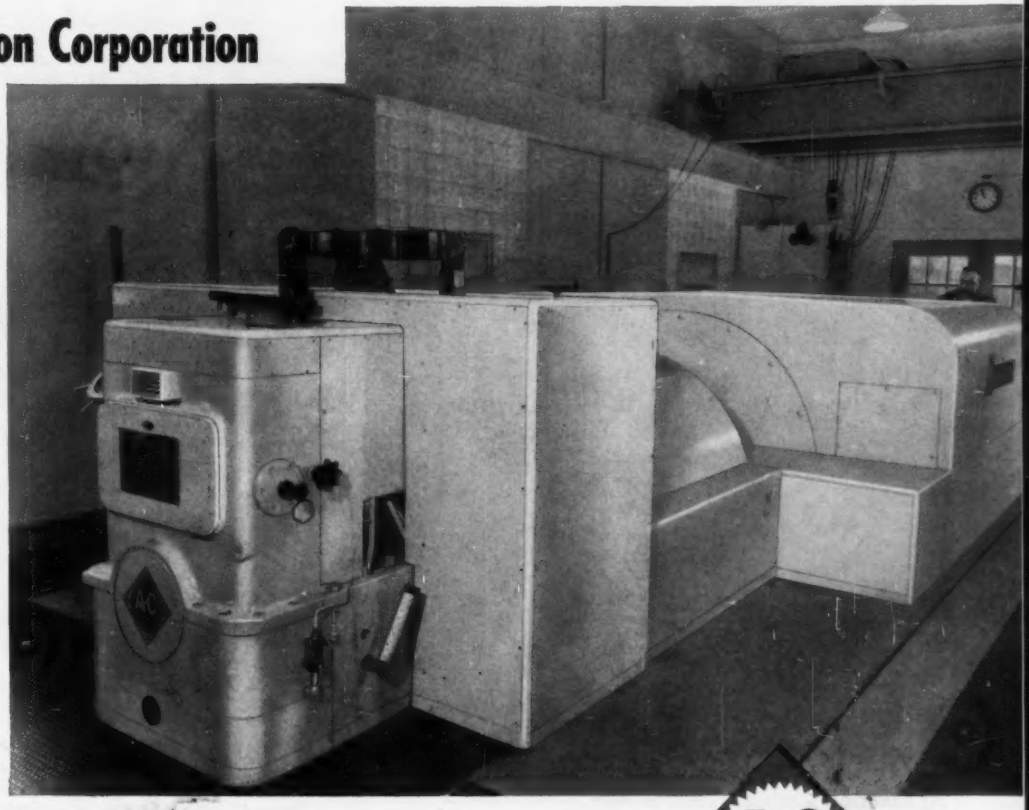
Particular care has been taken to promote ease of installation. Oil piping is above the floor line, eliminating need for trenches in the foundation. Generator gas coolers are located above the floor, eliminating ductwork through the foundation. Much of the work formerly done in the field is now performed in the factory. As a result, both turbine and generator can be shipped assembled ready for immediate installation.

For a detailed story on the advantages you can obtain with Allis-Chalmers steam turbine generating units, call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 03B7654. A-4868

At Marathon Corporation

ROTHSCHILD, WISCONSIN

4000-kw WA-Series unit produces power at 2400/4160 volts as a by-product of approximately 100,000 lb per hour of process steam. Steam conditions at turbine: 600 psig, 825 F, with 40 psig exhaust.



CHALMERS

A-C ALLIS-CHALMERS

Revolutionary Performance!

Riley Boiler Unit gives bonus of 20,000 pounds per hour of steam to Masonite Corporation

Here's the maximum capacity guaranteed to Masonite by Riley Stoker Corporation:

50,000 lb. continuous
60,000 lb. for 15 min. peaks

And here's the Masonite report on performance: "For the past 75 days the average hourly load on the new boiler has been 70,000 pounds with peaks of one and more hours' duration of 75,000 pounds."

This same installation called for a guaranteed air heater gas temperature not in excess of 395 degrees at 50,000 pounds of steam per hour. In actual operation at 54,500 pounds of steam per hour, the air heater exit gas temperature was only 377.5 degrees!

No wonder Riley Stoker Corporation, Worcester, Massachusetts, is so well known among leading plants throughout the nation for the highly efficient performance of its boilers!

Coppus-Dennis FANMIX Burners Were Installed

To assure such revolutionary performance, Riley specified Coppus-Dennis FANMIX Burners for its boilers. The exclusive FANMIX action — on *all* Coppus burners, gas as well as combination gas-oil — is the reason for such performances.

FANMIX : Better Combustion : Better Efficiency : Higher Ratings

FANMIX burners, with their *revolving orifices*, give violent mechanical mixing and agitation of gas and air and, therefore, instantaneous and complete combustion with *minimum excess air* (5% excess air not unusual).

Furnace space is not required for mixing; therefore, *higher boiler ratings* are easily obtained.

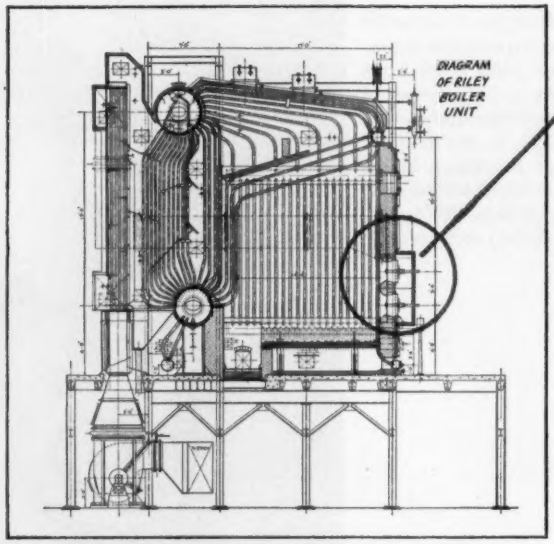
FANMIX burners, with shorter flame than any other burner, cannot cause flame impingement.

FANMIX burners, incorporating a *fan* as an integral unit, have *no draft loss* across the burner. Therefore, regardless of draft conditions, increased ratings are possible.

FANMIX action, with its quick completion of combustion, gives *lower* exit gas temperatures.

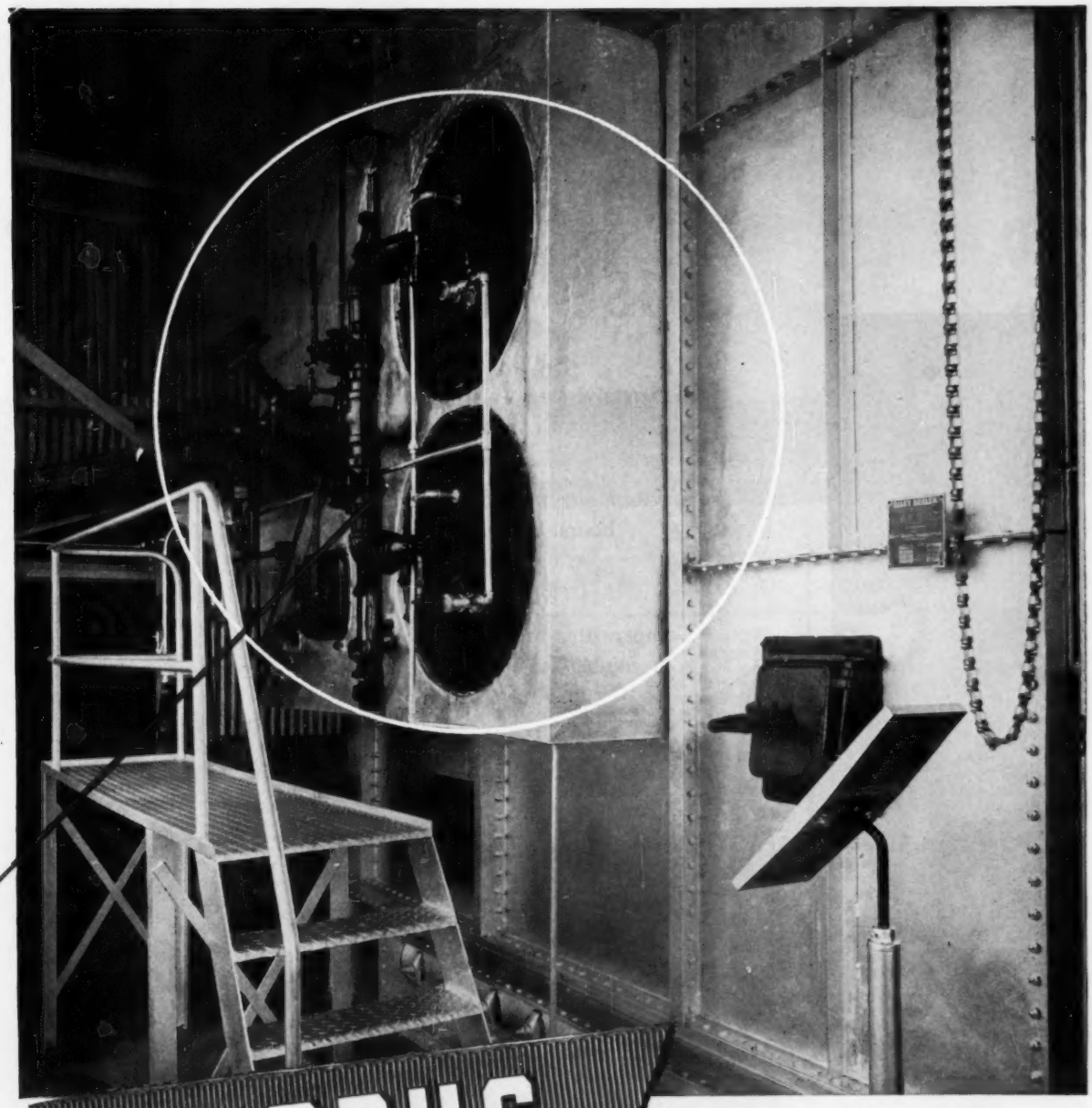
Plan now to take advantage of Coppus-Dennis FANMIX action with your present boiler. Remember — no forced draft equipment nor increase in stack nor increase in furnace volume is required for *FANMIX* operation to get increased capacity. And on *new* boilers, FANMIX lets you plan on reduced combustion space, higher ratings, less stack height or reduced induced draft capacity, and *no* forced draft equipment. Mail coupon today. Sales offices in *Thomas' Register*. Other "Blue Ribbon" Products in *Chemical Engineering Catalog, Refinery Catalog, Best's Safety Directory, and Mining Catalogs.*

JET REACTION is utilized to rotate fan which is integral part of burner. Automatically proportioned high velocity air passes at right angles through fuel to create ideal mixture for fast, complete combustion and peak efficiency.



Well-Known Users of Riley Units with FANMIX Burners Include:

Publicker Commercial Alcohol Co.
Monsanto Chemical Co.
Gaylord Container Corp.
Commercial Solvents Corp.
Celanese Corp. of America
Gulf Power Co.
Mississippi Power Co.
Eagle-Picher Lead Co.
Humble Oil & Refining Co.
Godchaux Sugars, Inc.
Kennecott Copper Corp.
Nicholson File Co.
Bird & Son, Inc.,
— and many others



RILEY BOILER UNIT, using FANMIX burners, is here shown as installed for the Masonite Corporation, Laurel, Mississippi. Circle in diagram at left indicates position of burners pictured above.

SEND COUPON for further information. Coppus engineers FANMIX burners to your individual requirements.

PLEASE ATTACH THIS COUPON TO YOUR COMPANY LETTERHEAD

COPPUS ENGINEERING CORPORATION
162 Park Avenue
Worcester 2, Massachusetts

Please send complete data on Coppus-Dennis FANMIX Burners. I'm particularly interested in
☐ gas ☐ combination gas-oil.

Name..... Title.....

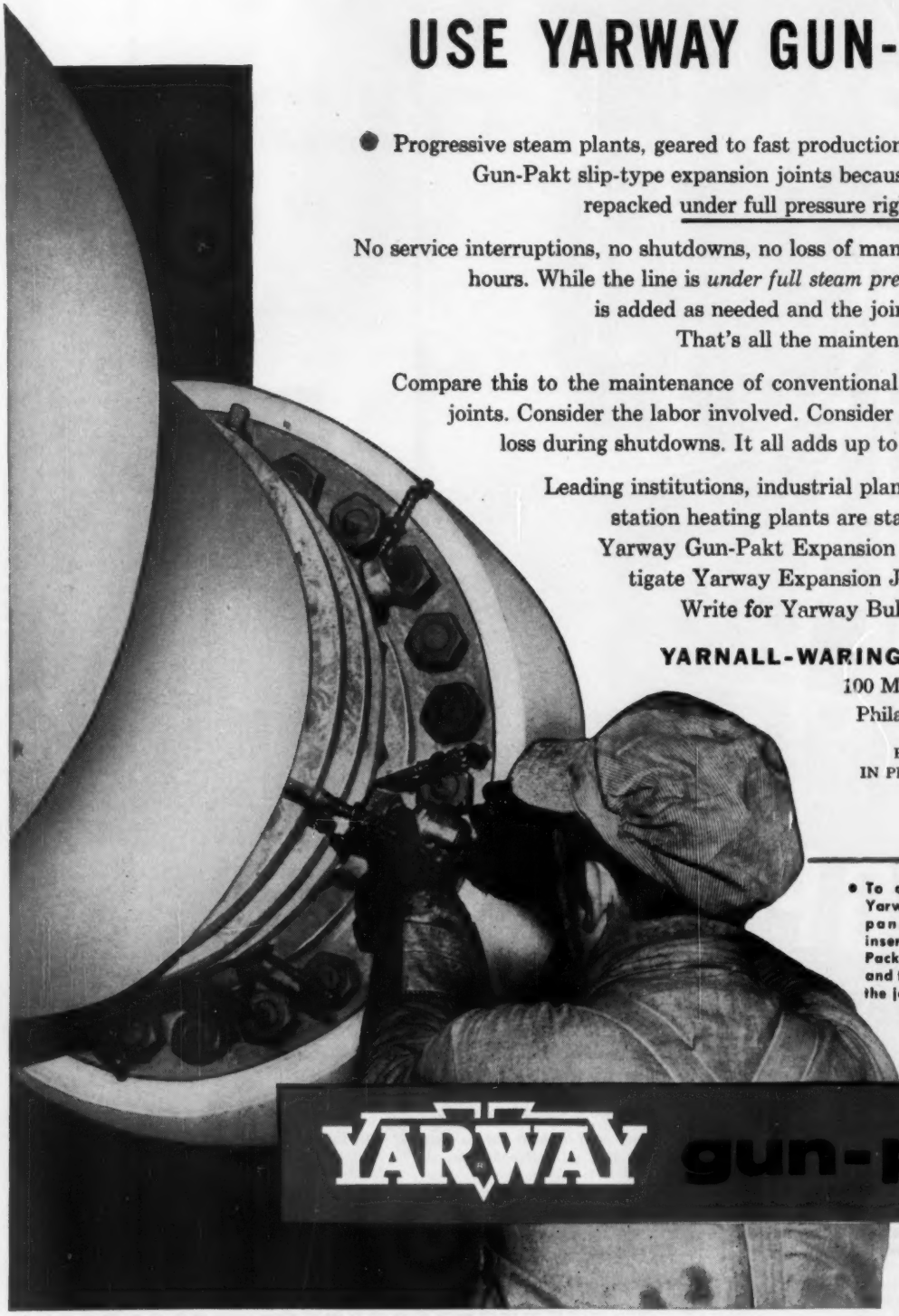
Company.....

Address.....

City..... Zone..... State.....

going places?

DON'T BOTHER TO UNPACK..
USE YARWAY GUN-PAKT



● Progressive steam plants, geared to fast production, use Yarway Gun-Pakt slip-type expansion joints because they can be repacked under full pressure right on the job.

No service interruptions, no shutdowns, no loss of man and machine hours. While the line is *under full steam pressure*, packing is added as needed and the joints lubricated. That's all the maintenance required.

Compare this to the maintenance of conventional gland-packed joints. Consider the labor involved. Consider also the profit loss during shutdowns. It all adds up to GUN-PAKT.

Leading institutions, industrial plants and central station heating plants are standardizing on Yarway Gun-Pakt Expansion Joints. Investigate Yarway Expansion Joints yourself. Write for Yarway Bulletin EJ-1913.

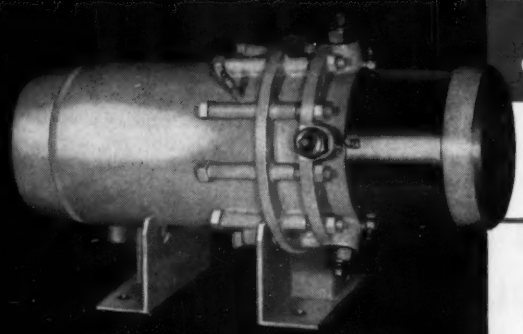
YARNALL-WARING COMPANY
100 Mermaid Avenue
Philadelphia 18, Pa.

BRANCH OFFICES
IN PRINCIPAL CITIES

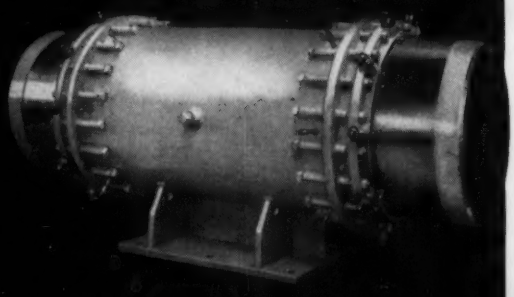
● To add packing to a Yarway Gun-Pakt Expansion Joint, just insert Yarway Plastic Packing, twist a wrench and the joint is tight . . . the job done. *There is no unpacking operation.*

YARWAY gun-pakt

EXPANSION JOINTS



Single end, welding-type Yarway Gun-Pakt Expansion Joint with base for pressures to 300 psi. 12 inch traverse.



Double end, welding type Yarway Gun-Pakt Expansion Joint with base for pressures to 300 psi. 24 inch traverse.

compare these maintenance records

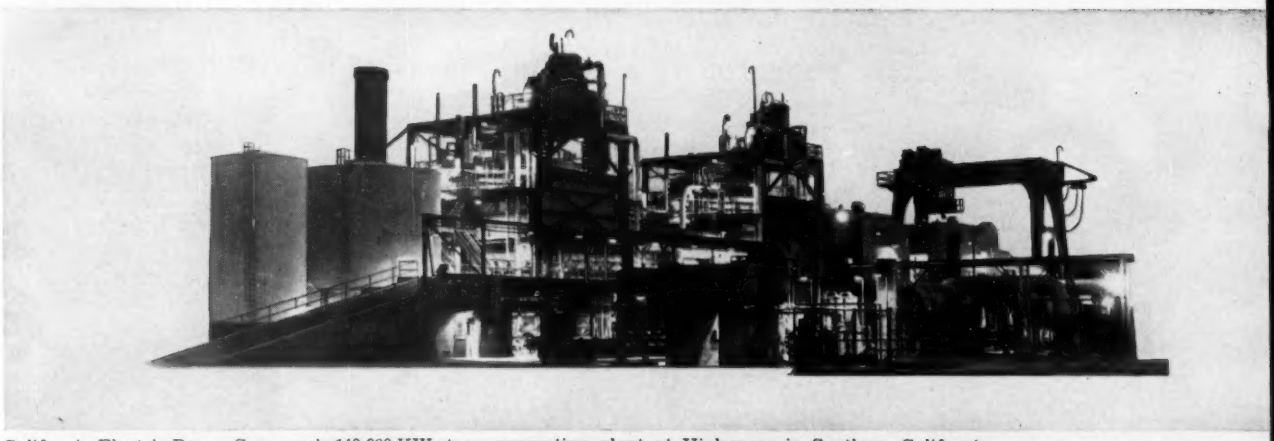
	YARWAY GUN-PAKT JOINTS	CONVENTIONAL GLAND-PACKED JOINTS
STATE UNIVERSITY*	Required addition of only 3 slugs (45 cents) of packing in 5 years. Lubrication only once every 6 months. Total labor time of only 2 manhours in 5 years.	Same lubrication as Gun-Pakt, *plus* gland tightening, *plus* complete overhaul with shutdown for unpacking and repacking every 3 to 4 years. Time for overhaul—25 manhours per joint!
MID-WEST AIRFIELD*	Only maintenance was lubrication and addition of 2 slugs (30 cents) of packing per year. Total labor ¼ manhour per joint per year.	Lubrication and gland tightening required 8 manhours per joint per year—plus complete unpacking and overhaul every 2 to 3 years. Time required for overhaul—20 manhours per joint.
"BIG TEN" UNIVERSITY*	Lubrication only once every 2 months, with packing added as needed. Total labor time charged, 1 manhour per joint per year.	General maintenance requires 6 manhours per joint per year. Complete overhaul required every 2 to 3 years with unpacking and repacking—24 manhours per joint.

*Name on request

expansion joints

OTHER YARWAY PRODUCTS

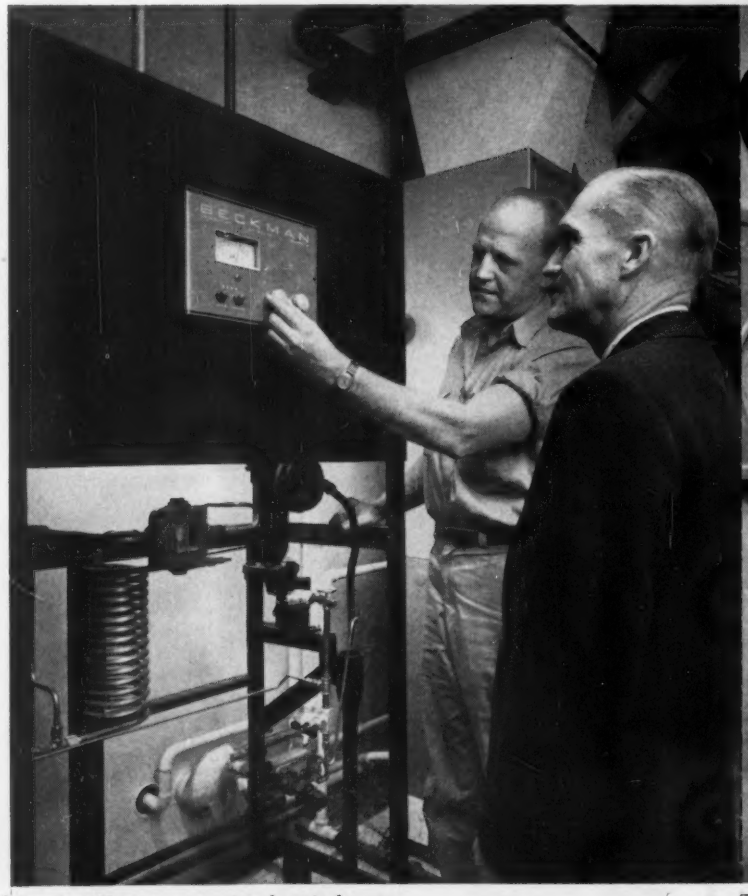
BLOW-OFF VALVES
WATER COLUMNS AND GAGES
LIQUID LEVEL INDICATORS
IMPULSE STEAM TRAPS
FINE SCREEN STRAINERS
SPRAY NOZZLES
DIGESTER VALVES
HYDRAULIC VALVES



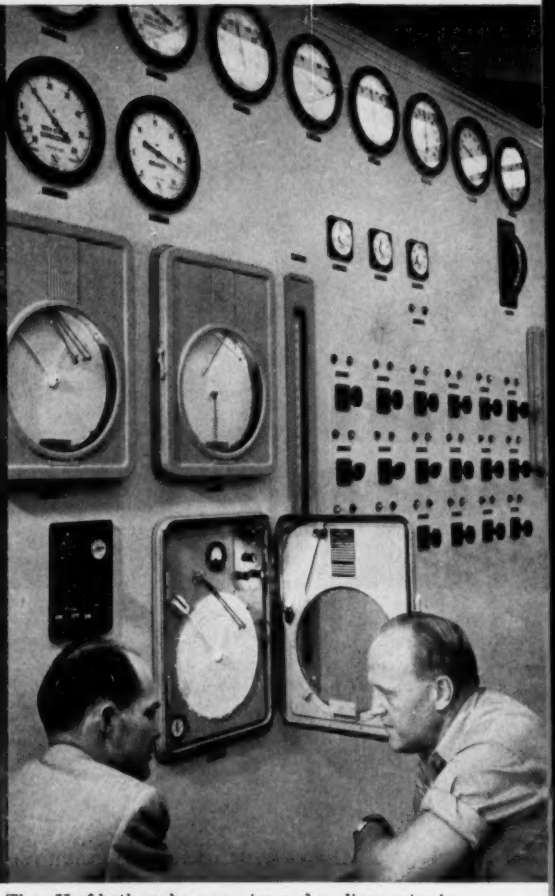
California Electric Power Company's 140,000 KW steam generating plant at Highgrove in Southern California.

problem: **13 POWER SHUTDOWNS IN ONE YEAR**

solution: **BECKMAN pH MEASUREMENT AND CONTROL**



Precise pH measurement and control means trouble-free operation at Highgrove.



The pH of both make-up water and cooling water is recorded simultaneously on a single recorder.

Free Engineering Service—by mail

A specially prepared System Analysis Form is available to help you isolate your continuous pH measurement problems. When form is returned to us with necessary data, Beckman engineers will mail you a written report suggesting suitable solutions, without cost or obligation on your part.

Beckman Division
BECKMAN INSTRUMENTS, INC.
Fullerton 1, California

☐ Please send me a pH System Analysis Form that will entitle me to a free engineering analysis and recommendation for solving pH problems at our plant.

☐ Please send me a copy of "Industrial pH Measurement and Control" and add my name to your mailing list to receive additional information on pH control.

*Name:*_____ *Title:*_____

*Firm:*_____

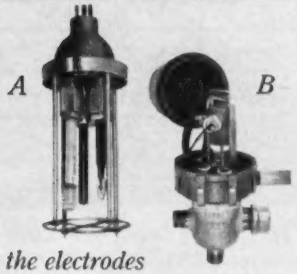
*Street:*_____

*City:*_____ *Zone*_____ *State*_____

N2-77

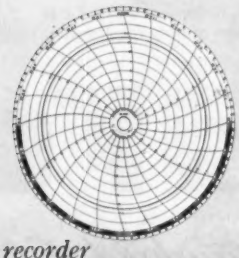
This coupon will bring you important information on pH.

Accuracy and reliability of Beckman pH measurement and control were major factors in overcoming a series of costly shutdowns during the first two years of operation at the California Electric Power Company's new steam-electric power plant at Highgrove, California. Beckman electrodes and pH meters were included as key instrumentation in the cooling water circulating system for the plant's first two units.



1. the electrodes

2. the pH meter



3. the recorder

Beckman pH equipment is also sold through recorder-controller companies.

Daily permanent records of wide variations in pH helped solve a troublesome water treatment problem which caused 13 shutdowns in one year.

Condenser efficiency dropped, generating capacity was curtailed, main cooling water pipes had to be lined and maintenance costs skyrocketed.

Cooling water causes damage

A portion of the plant's cooling water comes from an irrigation canal carrying effluent from the city of Colton to the north. This water contains detergents in solution. A thin calcium phosphate film formed on condenser tubes, causing a marked loss in efficiency. Back pressure was a serious problem. Condensers had to be shut down and cleaned 13 times during one year with resulting loss in generating capacity. The 72-inch steel water pipelines from cooling towers to condensers corroded and were centerlined with cement.

pH control is plant protection

Complete, accurate and permanent records of pH trends in cooling water helped Highgrove personnel revise water treatment procedure and obtain more precise addition of chemicals for pH control. Eight months later condensers were opened for inspection and required absolutely no maintenance. Back pressure problem had disappeared. Pipe corrosion and deterioration of wooden cooling towers was arrested. One year later none of the units had been shut down once because of cooling water problems.

When units 3 and 4 were built, Beckman industrial pH instrumentation was again specified, this time incorporating fully automatic addition of chemicals to maintain cooling water at the desired 7.3 to 7.6 pH range.

Make-up water also controlled

Beckman pH electrodes and meters also keep a constant check on boiler make-up water which is held between 8.8 and 9.0 pH to prevent corrosion in the wet stages of the turbine and condensate systems. With this precise and unvarying pH control, condensate systems are virtually free of any trace of corrosion. Beckman electrodes are cleaned and buffered just once a month. Accuracy is within .2 pH unit and could be maintained closer if necessary. Electrical interference from generators is negligible.

BECKMAN INDUSTRIAL pH CONTROL

Throughout industry, Beckman continuous automatic pH measurement and control systems are increasing the operating life of equipment, lowering maintenance costs, insuring the quality of products, and providing permanent records of efficient operation. It consists of three simple elements:

1. The Electrodes Beckman glass electrodes are almost unbreakable and require very little care. They may be mounted in immersion (A) or flow (B) assemblies.

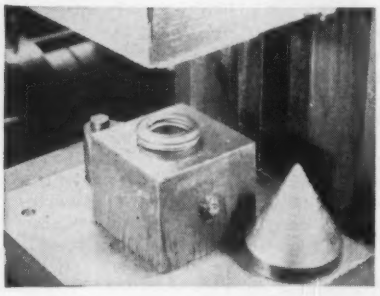
2. The pH Meter Beckman pH meters are famous around the world. Sturdy, accurate and dependable, they amplify the small voltage from the electrodes and translate it into pH units. One meter can monitor (manually or automatically) six different points in process systems, giving either simple meter indications or automatic recording and controlling. Meters can be located as far as 200 feet from electrode assemblies.

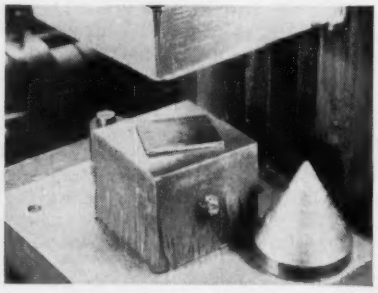
3. The Recorder Beckman pH instruments may be used with all leading makes of recording and controlling equipment. The recorder is connected to the pH meter and charts a permanent record. It may be mounted in a central control room at any distance from the meter.

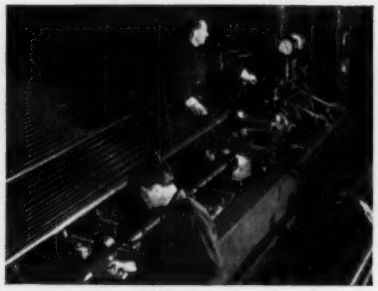
These extras make ELECTRUNITE

	TESTS	ELECTRUNITE BOILER TUBES	ASTM A-178 ASME SA-178	ASTM A-226 ASME SA-226	A.A.R. M-108	SEE NOTE*	FEDERAL WW-T-731b	MIL-T-17188	MIL-T-20160	MIL-T-20162 MIL-T-20169
Before Welding	Chemical Composition	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Gage Check	✓								
Production Control	Flattening	✓								
	Reverse Flattening	✓								
	Expansion	✓								
	Flange	✓								
	Metallurgical Laboratory	✓								
Finished Tube	Flattening	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Flange	✓	✓	✓	✓	✓	✓	✓		
	Crush	When Required	When Required		When Required	When Required				
	Reverse Flattening	✓	✓	✓		✓				
	Tensile	✓							✓	✓
	Hydrostatic	✓	✓	✓	✓	✓	✓	Optional	✓	✓
	Non-Destructive Electric	When Required	In lieu of Hydrostatic	In lieu of Hydrostatic			In lieu of Hydrostatic	All or part required		Optional
	Final Inspection	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Protective Coating	✓					✓	✓		

*NOTE: Tests in this column specified in American Bureau of Shipping, Sec. 40 par. 66-83; Treasury Dept., U. S. Coast Guard-Marine Engineering Regulations 51.01, 51.25, 51.28, 51.34.







THESE TESTS ARE TYPICAL of those listed in the chart above, showing: 1, axial crush test; 2, flatten test with weld at point of maximum bend; 3, hydrostatic test of each completed tube, at a pressure in excess of code requirements.

REPUBLIC

REPUBLIC STEEL

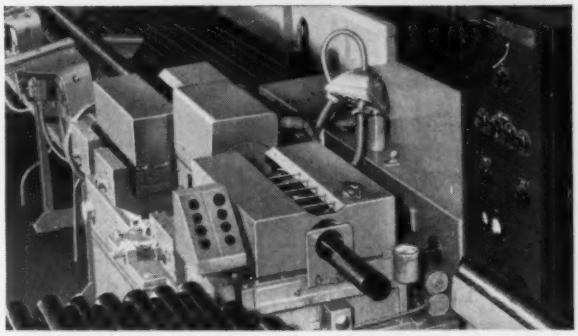
World's Widest Range of Standard Steels

...the most thoroughly tested tubing you can buy

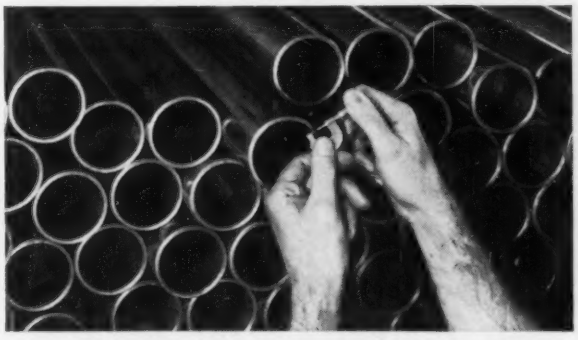
Let's face the facts: the true test of boiler tubing is its performance in actual service . . . but you have to know the results before installation. That's why Republic ELECTRUNITE® Boiler Tubes are your best choice, whether you are installing a new boiler or retubing an existing unit. ELECTRUNITE, the original electric resistance welded tubing, is backed by more than a quarter century of manufacturing experience plus the most thorough quality control and testing program in the world.

This program assures quality from raw ore to finished product and includes not only all tests required by applicable specifications (see chart), but *complete production control tests* during manufacture, as well. In addition, Republic alone offers FARROWTEST®, the electronic nondestructive test, which, when you specify it, peers *inside* your tube walls to detect and reject any flaws. Republic quality, verified by FARROWTEST, will meet the strictest specifications. It is your best evidence that ELECTRUNITE Boiler Tubes, when properly installed and maintained, will give years of dependable, trouble-free service.

On your next order for boiler tubes, get the best. Get Republic. Just call your local Republic representative or mail the coupon for further information.



FARROWTEST . . . DEVELOPED BY REPUBLIC is the most conclusive, nondestructive tubing test in use today. Electronically operated, its detector coils can spot defects in tube walls which would be hidden from routine test procedures. You can specify FARROWTEST on ELECTRUNITE Boiler Tubing instead of your present method at no extra cost.



UNIFORMITY IS THE KEY to easier, faster installation when you use ELECTRUNITE Boiler Tubes. They slide into headers and drums easily, expand evenly with less rolling, and bead over quickly. Republic manufacturing methods "build-in" uniform wall thickness, diameter, strength, ductility, microstructure and surface. Testing verifies these characteristics in each tube you receive.

REPUBLIC STEEL CORPORATION
3144 East 45th Street • Cleveland 27, Ohio

Please send me more information on:

☐ ELECTRUNITE Boiler Tubes
☐ FARROWTEST

Name_____ Title_____

Company_____

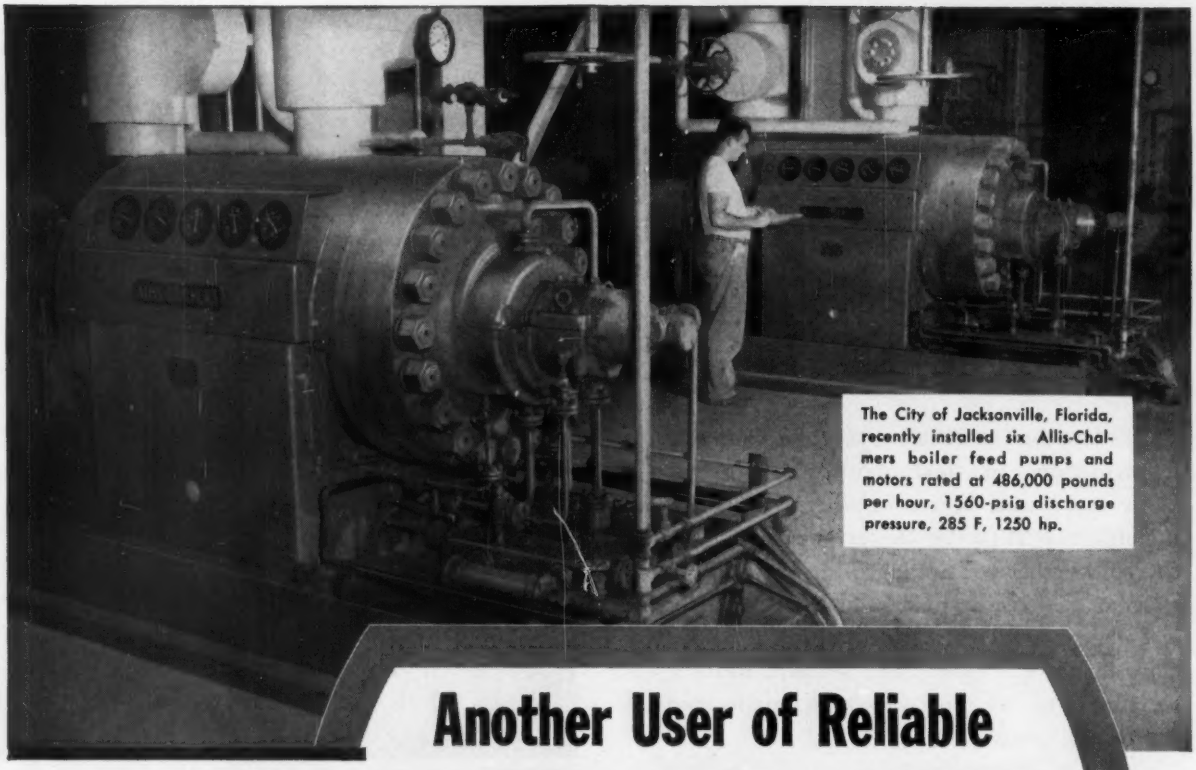
Address_____

City_____ Zone____ State_____

K-8923

STEEL

and Steel Products



The City of Jacksonville, Florida, recently installed six Allis-Chalmers boiler feed pumps and motors rated at 486,000 pounds per hour, 1560-psig discharge pressure, 285 F, 1250 hp.

Another User of Reliable ALLIS-CHALMERS barrel-type PUMPS

City of Jacksonville

Here are the reasons **for wide acceptance of these pumps:**

- Outstanding performance — fully proved by service records.
- High efficiency and smooth operation under fluctuating loads — first stage has twin, single-suction impellers for low NPSH requirements.
- Simple maintenance—expansion joint and shaft seals are brought to outside of pump where they can be easily inspected.
- No balancing device needed—axial balance is maintained by back-to-back mounting of the impellers.

THERE are outstanding features like these throughout the Allis-Chalmers line. Whether you require boiler feed, condensate, circulating or other power plant pumps — it pays to standardize on Allis-Chalmers.

In addition, A-C can supply pumps, motors and control of coordinated design and manufacture. This means one responsibility — one guarantee of satisfaction.

Get complete information on barrel-type boiler feed pumps. Call your nearby A-C office or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin for Bulletin 08B7899.

A-4854

ALLIS-CHALMERS

Multiply This Monobed Resin by 30,000

Water conditioning engineering firms are being continuously called upon to supply systems capable of delivering boiler feedwater from which virtually all dissolved salts have been removed. Where the ultimate in ion-free water is demanded, those water conditioning experts are now recommending AMBERLITE® MONOBED exchange resins.

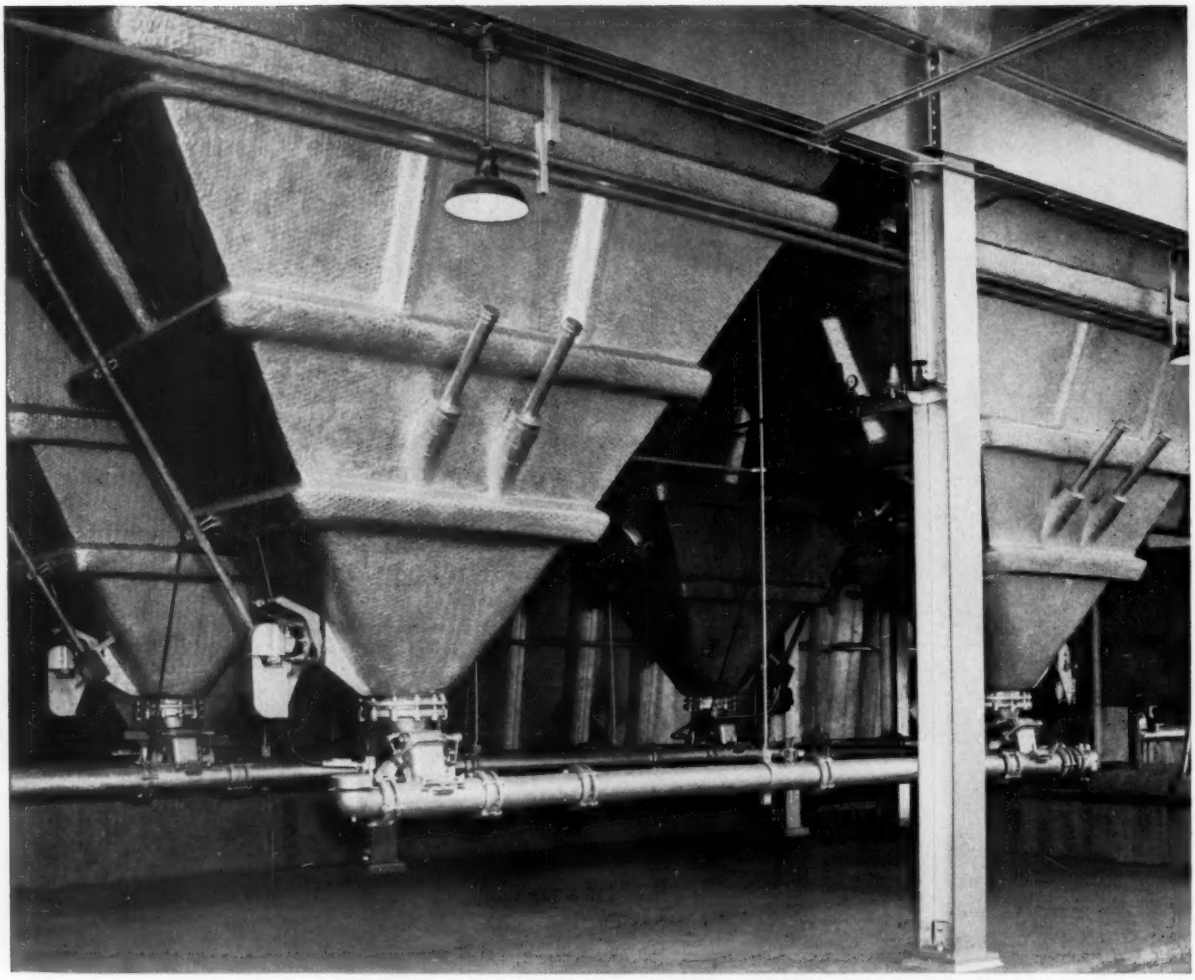
From laboratory research columns like the one above, and from long experience in the field, Rohm & Haas Company has developed ion exchange resins used in industrial deionization systems 30,000 times as large as the one pictured here. One such system is capable of treating 5000 gallons of water per minute continuously, producing an effluent of a quality comparable to that obtainable in the laboratory.

AMBERLITE MONOBED resins are being used with water-cooled atomic power reactors, too. Water is circulated through deionizing columns to prevent scaling of piping and contamination of reactor components by radioactive ions.

Ask for "If You Use Water . . . ," a 24-page booklet of basic information on the ion exchange treatment of water.

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION, PHILADELPHIA 5, PENNSYLVANIA



HEAT LOSSES ARE MINIMIZED by K&M "Featherweight" 85% Magnesia insulation on these fly-ash hoppers at the Meramec Power Plant of the Union Electric Company of Missouri, St. Louis. It is highly efficient to 600°F. Elsewhere in the plant, "Featherweight" is applied in combination with K&M Hy-Temp for efficiency to 1900°F. Insulation contractor: Armstrong Cork Company.

Keep steam hotter–longer–at less cost– with K&M thermal insulations

K&M insulations give you highly efficient, cost-cutting insulation in every service temperature range. Whether used for maximum conservation of heat, protection of personnel, or control of room temperature, these insulations have proved their effectiveness through more than 65 years of use. K&M "Featherweight"® 85% Magnesia and K&M Hy-Temp insulations will serve for the life of your equipment. For efficiency to 1900° F., they are applied in combination, with staggered joints. This eliminates the heat loss that normally occurs in single-layer installations when expansion causes joints to open. Where severe water exposure or high humidity may be a problem, K&M "Featherweight" Water-Resistant Magnesia insulation is especially effective to 450° F.

Your K&M Distributor—who is an experienced applicator—will be glad to give you complete information on K&M thermal insulations. Or, write us.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

K&M best in asbestos®

In Canada: Atlas Asbestos Company, Limited; Montreal, Toronto, Winnipeg and Vancouver

Twin Benefits from Mead-Morrison COAL UNLOADER

Greater Economy

because of Mead-Morrison's progressive reeving system

This system, originated by Mead-Morrison, utilizes a single continuous rope for both the hoisting and closing motions of the grab bucket. The rope is fed into the system from a storage reel in small increments to replace worn portions of the rope. By thus distributing the wear the rope is used more efficiently and a longer rope life is realized than is possible with any two-rope system.

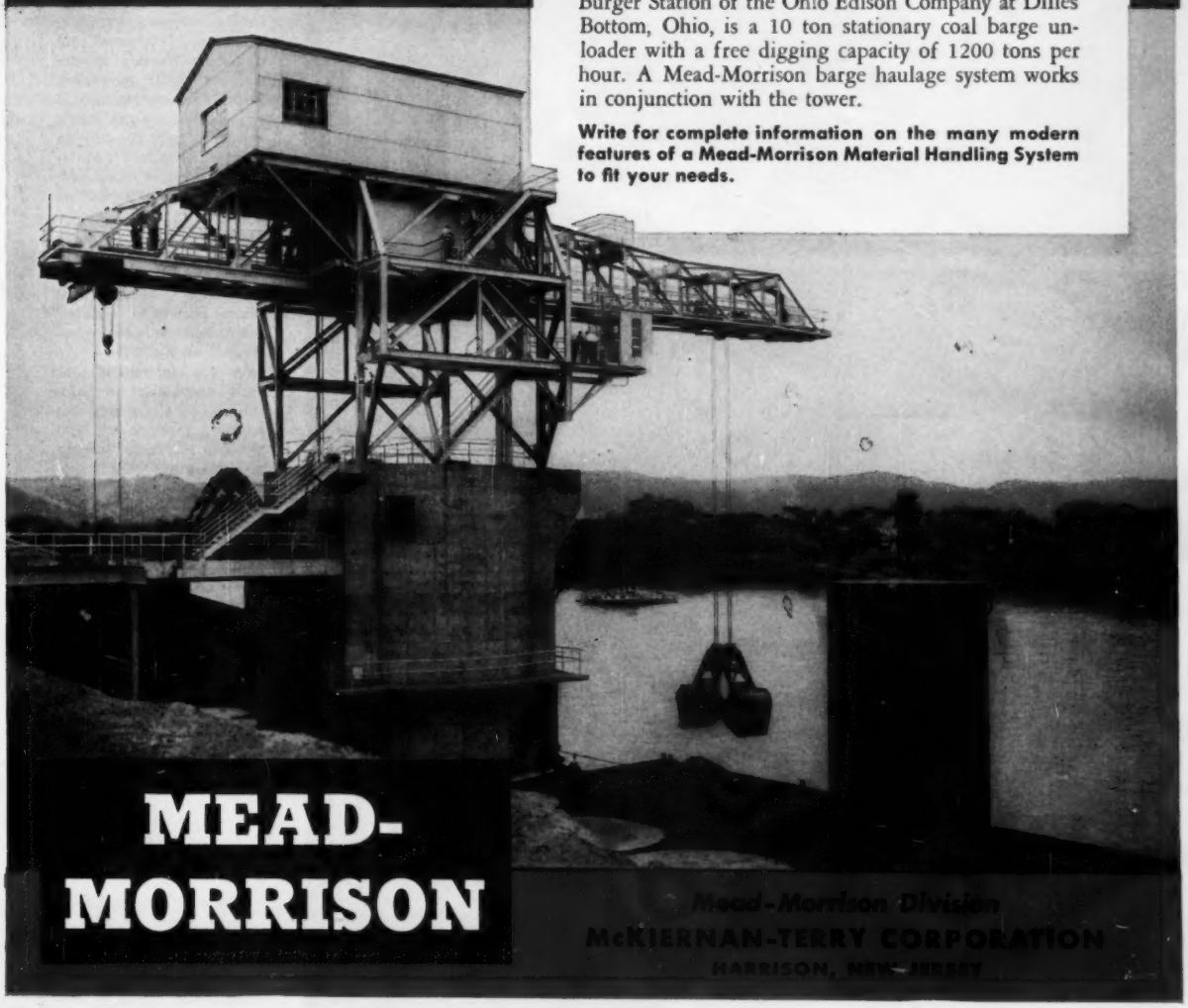
Greater Safety

because of Mead-Morrison's "dead man" control

All motions of the bucket are controlled by two short, latched levers. The operator is not forced to shift his hands from these levers at any time in the operating cycle. If the operator removes his hand from any lever for any reason, that motion is automatically stopped, thereby preventing uncontrolled motion which might cause terrific damage.

This Mead-Morrison Tower installed at the R. E. Burger Station of the Ohio Edison Company at Dilles Bottom, Ohio, is a 10 ton stationary coal barge unloader with a free digging capacity of 1200 tons per hour. A Mead-Morrison barge haulage system works in conjunction with the tower.

Write for complete information on the many modern features of a Mead-Morrison Material Handling System to fit your needs.

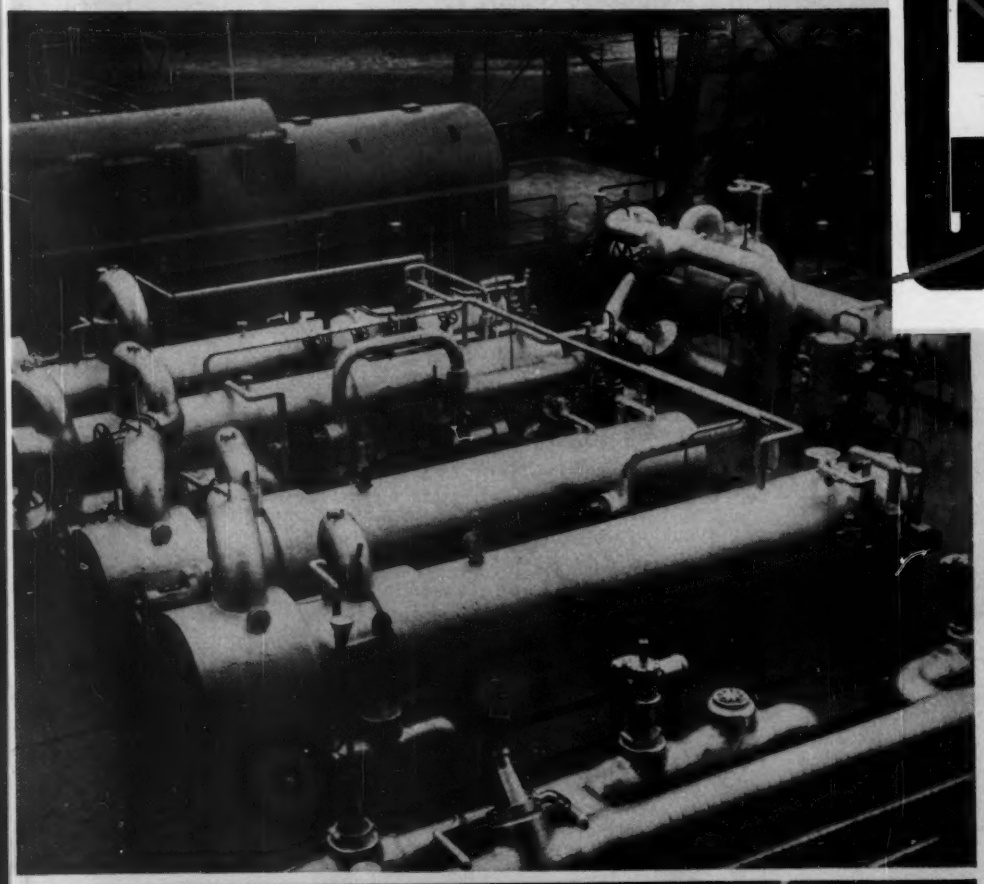


MEAD-MORRISON

Mead-Morrison Division
McKIERNAN-TERRY CORPORATION
HARRISON, NEW JERSEY

One of a series telling
how the producing companies of
General Precision Equipment Corporation
are contributing to America's progress.

GPE



Griscom-Russell feed water heaters in a 125,000 KW public-utility power station; save nearly 100 tons of coal per day. Heaters handle flow of water exceeding 2000 G.P.M. at 2500 pounds pressure and steam extracted from the turbine at five different points; "train" of five units preheats water fed to boilers from 90° F. to 441° F.

Askania multiple fuel boiler control panel in large steel plant; maintains metered proportion between combustion air and fuels—coke oven gas and fuel oil—for most economical combustion; holds steam pressure constant through all load changes and keeps furnace pressure at a safe and predetermined value.

GPL *ii-TV* camera; basic element in the *industrial* and *institutional* TV System of General Precision Laboratory. Used to monitor and improve manufacturing processes, view and control dangerous operations, watch over restricted areas.

The highly advanced technological products designed and manufactured by the eighteen producing companies of General Precision Equipment Corporation serve more than a dozen major industries. Products of six of these GPE Companies—Griscom-Russell, Askania, Librascope, Link, Kearfott and General Precision Laboratory—have widespread application in the processing and power industries.

Industrial Processing...and Power

The Griscom-Russell Company is one of the country's largest producers in the fields of heat exchange and water distillation. It is the pioneer in heat exchanger equipment—the key to the whole complex of modern industrial processing and power. For over seventy years, G-R equipment has been responsible for greatly increased efficiency and lowered operating costs in industry.

Askania Regulator Company for a quarter of a century has been a leading developer in the field of regulators and controls, including components and systems. Its products are widely used by the power, steel, gas and coke, mining, chemical, petroleum, glass and paper industries—wherever great reliability and accuracy are essential.

Kearfott Company, Inc.; Librascope, Incorporated; and Link Aviation, Inc. produce a wide variety of precision instruments, computers, servos and other control components for equipment and systems used throughout the power and the processing industries. Industrial television equipment manufactured by General Precision Laboratory Incorporated, the sixth GPE Company active in these fields, is playing increasingly important roles in "seeing eye" monitoring operations in these industries.

Each company in the GPE Group works in specific, highly specialized technical areas, as indicated in the chart below. Each of these companies, in addition to specializing in its particular products and fields of technical competence, has at its command, as required, the facilities and specialized techniques of the other GPE Companies in their respective fields. Interrelation is achieved through GPE's basic operating policy, Coordinated Precision Technology.

In the fields of research and development, GPE Coordinated Precision Technology permits a high degree of specialization in particular areas of competence and supplements such specialization by the application of techniques in other fields, as desirable. In the field of production, it makes possible a highly flexible application of facilities. This policy has been responsible for a diversified line of precision equipment of superior design and performance, covering a wide range of both standard and special uses.

Perhaps the most conspicuous advantage of GPE Coordinated Precision Technology is that the concept and development of equipment, and of solutions to the underlying technical problems, are not restricted or distorted by traditional allegiance to specialization in a particular field. GPE coordination permits the engineers and technical personnel of each GPE Company to seek the optimum solution for the customer within the total capacities of the GPE Companies as a group.

● Manufacturing
●● Manufacturing and product development
●●● Manufacturing, product development and research
□●● Pilot manufacturing, product development and research

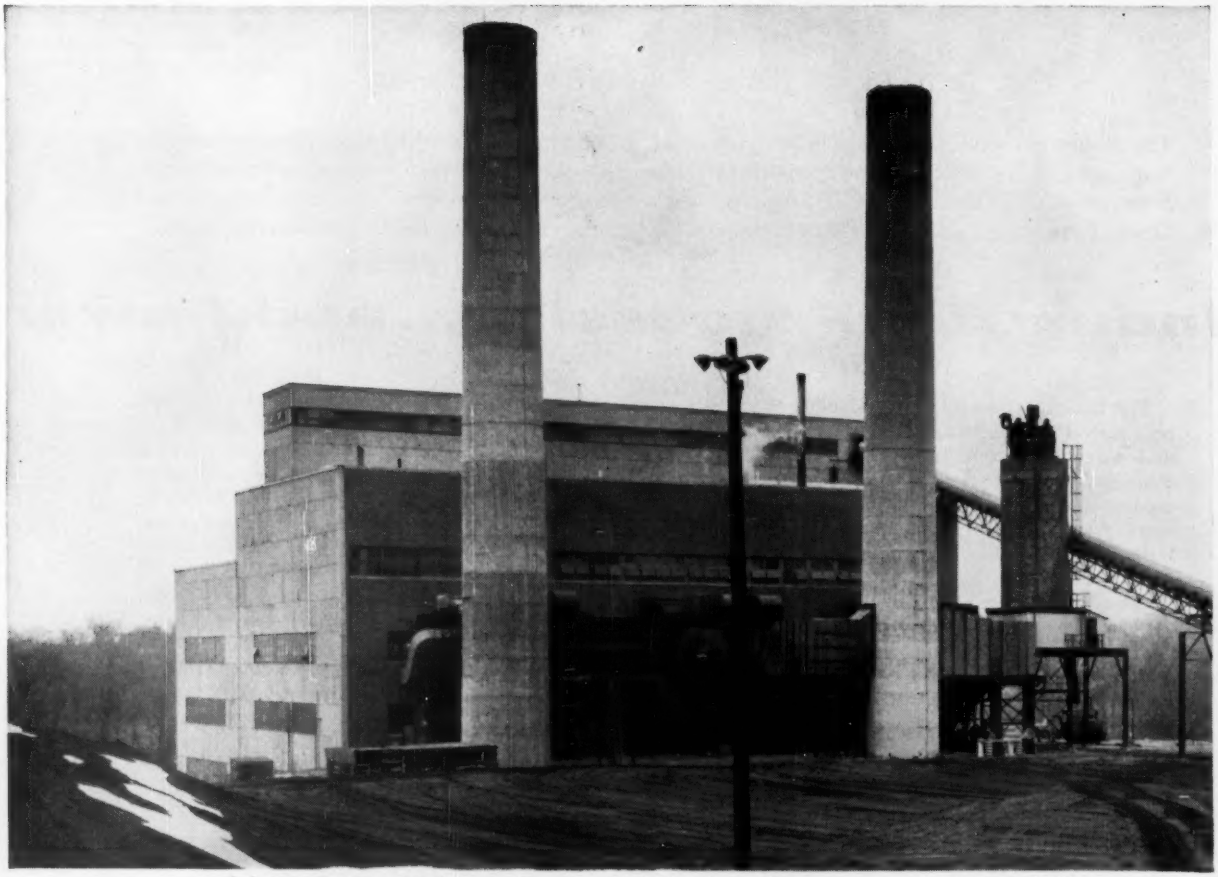
	Kearfott Company, Inc.	International Projector Corporation	Bludworth Marine Division	General Precision Laboratory Incorporated	The Griscom-Russell Company	Link Aviation, Inc.	The Hertner Electric Company	The Strong Electric Corporation	J. E. McAuley Mfg. Co.	Askania Regulator Company	Ampro Corporation	Librascope, Incorporated
PRECISION MECHANICS, OPTICAL DEVICES, CERAMICS	●●●	●●	●●	□●●	●●	●●●	●●	●●●	●●	●●	●●	●●●
ELECTRICAL EQUIPMENT and COMPONENTS	●●●	●	●			●●●	●●●	●●	●	●●	●	●●●
ELECTRONICS	●●●	●●	●●●	●●●		●●●	●	●●		●●●	●●	●●●
HYDRAULICS, LIQUIDS PROCESSING, HEAT EXCHANGE		●●			●●●					●●●		
TELEVISION Studio, Theatre, Educational, Business, Industrial	●	●		●●●		●				●		
INSTRUMENTS, SERVOS, CONTROLS Hydraulic, Pneumatic, Magnetic, Electronic	●●●	●	●●	□●●		●●●	●●	●●		●●●	●	●●●
AIRCRAFT and MISSILE GUIDANCE, CONTROL, SIMULATION	●●●	●		●●●		●●●	●			●●	●	●●●
AUTOMATIC COMPUTERS and COMPONENTS	●●●	●	●	□●●		●●●				●●●		●●●
RADAR, MICROWAVE, ULTRASONICS	●●●	●	●●	●●●		●●		●		●		
MOTION PICTURE and AUDIO EQUIPMENT		●●●		□●●			●●	●●●	●●●		●●●	
NUCLEAR POWER COMPONENTS and CONTROLS	●●●				●●					●●		●●●
SYSTEMS ENGINEERING Aeronautical, Naval, Industrial	●●●			●●●	●●●	●●●				●●●		●●●

THE GPE PRODUCING COMPANIES

A brochure relative to GPE Coordinated Precision Technology and the work of the GPE Companies is available. Address your request, or inquiries on specific problems, to:

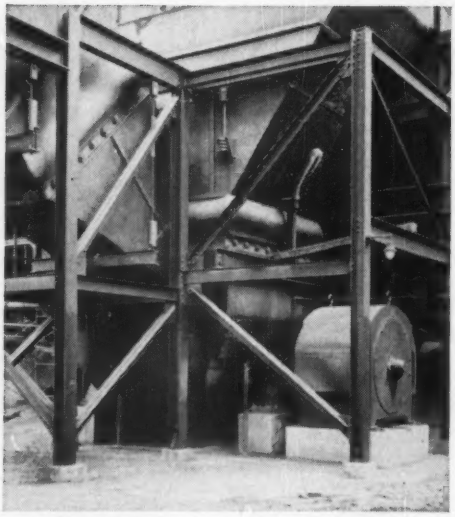
General Precision Equipment Corporation

92 GOLD STREET, NEW YORK 38, NEW YORK



Sabrooke Station's third generating unit adds 30,000 kw; raises system capacity of Central Illinois

Demand tops 100,000 kw mark



American Blower Sirocco Induced Draft Fan at Sabrooke Station is rated at 184,000 cfm @ 340° F @ 14.5″ sp @ 600 hp. American Blower Draft Fans are also installed at company's Fordam Station.

Central Illinois Electric and Gas Co. puts new generating unit on the line to meet area needs; relies on American Blower Mechanical Draft Fans.

Shortly after the third steam-generating unit began operation in October 1955 at Sabrooke Station, the Central Illinois Electric and Gas Co. marked a milestone. *For the first time in the company's history*, the electrical needs of its Rockford service area exceeded 100,000 kw!

Indeed an important event, the new unit demonstrates this growing company's ability to more than meet the demands of the future . . . a future in which American Blower equipment has an important role.

Like the Central Illinois Electric and Gas Co., many other progressive, investor-owned utilities have also decided on American Blower equipment. They know from past-performance records that American Blower products are reliable, and are built to meet rigid power-plant requirements.

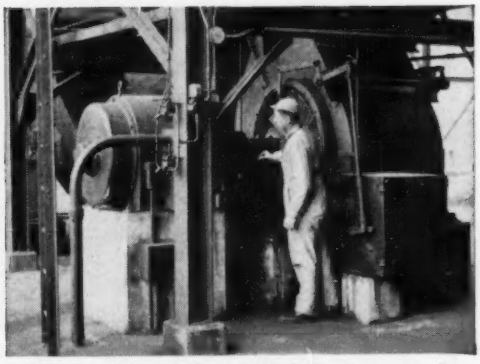
We'd be pleased to give *you* full facts on our Mechanical Draft Equipment, Fly Ash Precipitators, Heavy Duty Steam Coils, and Gyrol Fluid Drives for boiler feed-pump and fan control. Just give our nearby branch office a call.

American Blower

reports on progress in power

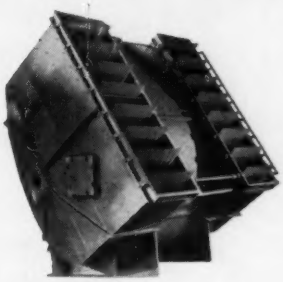
Electric and Gas Co. to 156,450 kw.

in Rockford, Ill.

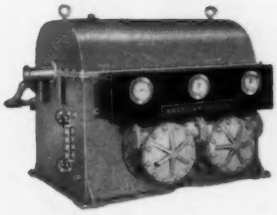


American Blower Forced Draft Fan has capacity of 104,000 cfm @ 90°F @ 9.5" sp @ 250 hp.

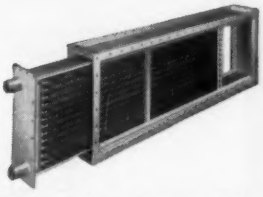
AMERICAN BLOWER PRODUCTS SERVE AMERICA'S POWER NEEDS



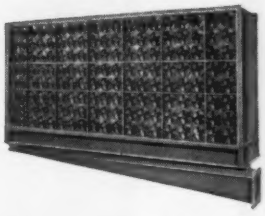
Mechanical Draft Fans for forced and induced draft.



Gýrol Fluid Drives for boiler feed-pump and fan control.



Heavy duty steam coils for high-pressure duty.



Collectors and precipitators for dust and fly ash control.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICH. • CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

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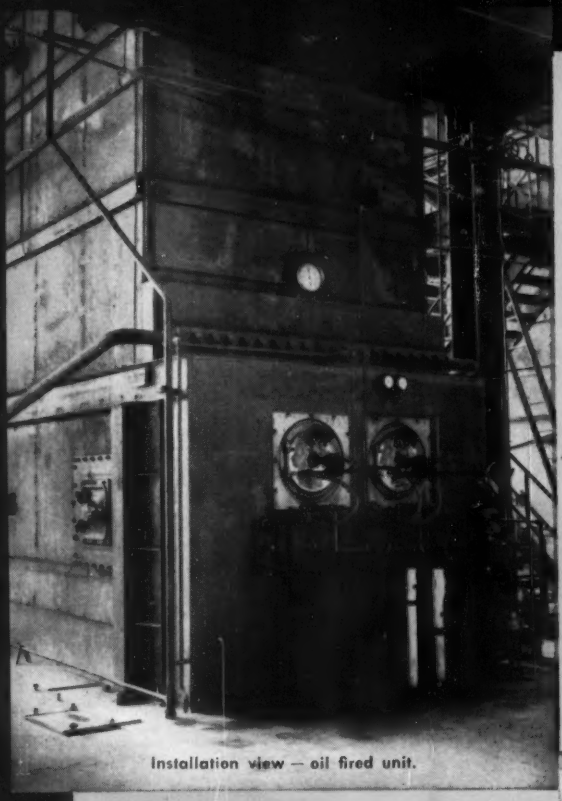
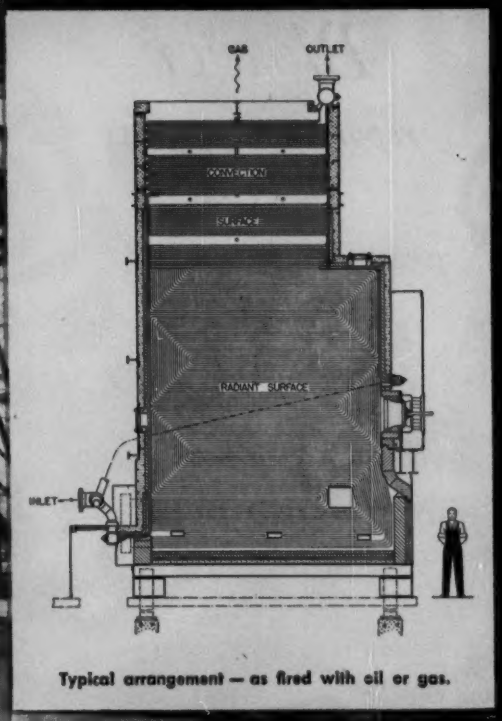
AMERICAN 75th ANNIVERSARY YEAR American Blower 1881-1956 **BLOWER**

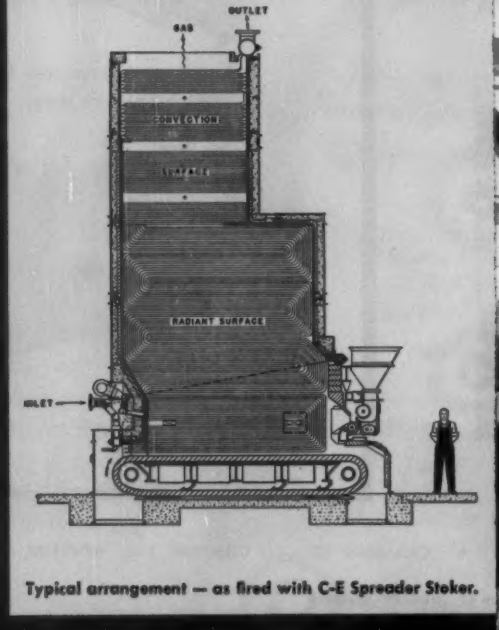
C-E LaMont Controlled Circulation Hot Water Boilers



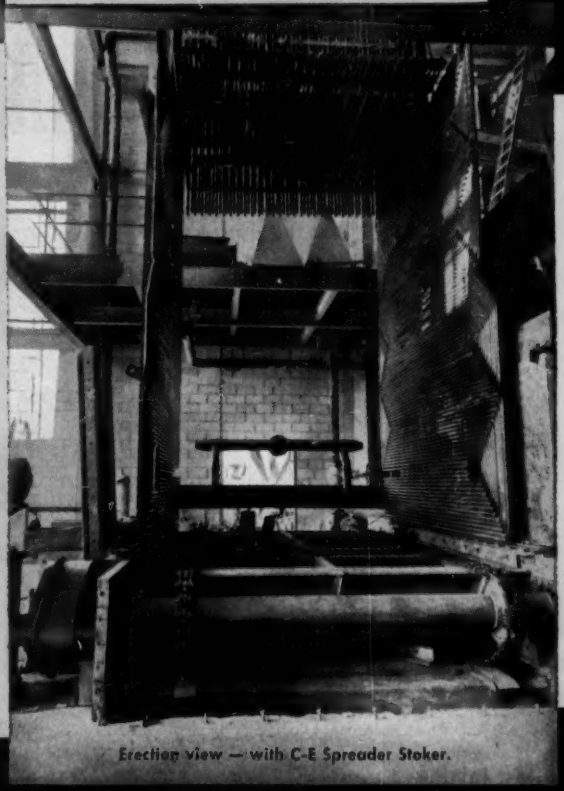
Installation view — oil fired unit.



Typical arrangement — as fired with oil or gas.



Typical arrangement — as fired with C-E Spreader Stoker.



Erection view — with C-E Spreader Stoker.

Ever consider High Temperature Water for your heating and processing needs?

Both steam and high temperature water have their place, and your particular requirements will determine which is best for you. In either case, the complete C-E line includes a type and size of boiler exactly suited to your needs. Where high temperature (HT) water seems indicated, it affords such important advantages as:

1. **The higher available heat in HT water — many times that of steam at the same pressure.**
2. **Closer control of temperature.**
3. **Heat loss is lower with the HT water closed system . . . unused heat returns to the boiler . . . no condensate return lines.**
4. **No elaborate feedwater treatment required. Make-up requirements are exceptionally low.**
5. **Steam traps not required — trap problems and attendant expense are eliminated.**
6. **No blowdown losses . . . no safety valve vent losses . . . no condensate losses.**

The planning of any new heating and/or processing system should include the consideration of a high temperature water system. There are many hundreds of HT water installations operating abroad and a rapidly growing number in the U. S. A. It may be *just right* for *your* requirements.

B-886

Advantages of the C-E "HT" Water Boiler

Once it is established that HT water is right for your needs, your next concern is selection of proper equipment. The C-E high pressure, high temperature water boiler has inherent advantages that make it the best possible choice. It is especially designed for HT water applications utilizing as it does the principle of forced, controlled circulation which is extended throughout the entire system. This accounts for numerous points of superiority in the C-E LaMont Controlled Circulation Hot Water Boiler. Among these are:

1. **Complete control over HT water movement in both system and boiler.**
2. **No separate boiler pump is required, since low pressure loss is inherent.**
3. **Pressurized operation with oil or gas means no induced draft fan.**
4. **Single-pass design — no baffles — means cleaner boiler and lower draft loss.**
5. **More efficient heating surface can be arranged because of controlled, positive circulation.**
6. **Any fuel — oil, gas, coal, or any combination of fuels.**
7. **Other features such as: gastight, welded steel casing . . . fewer headers, all of which are accessible.**

The C-E LaMont Controlled Circulation Hot Water Boiler is available in sizes ranging from 10 to 200-million Btu per hour, or more, with pressures up to 500 psi and temperatures to 475 F — higher if required.

If you are in the market for a heating or process system — or expect to be — by all means investigate high temperature water and the C-E "HT" Water Boiler. Our engineers will be pleased to discuss the subject with you or your consultants. Write for our new catalog HT-102.

COMBUSTION ENGINEERING

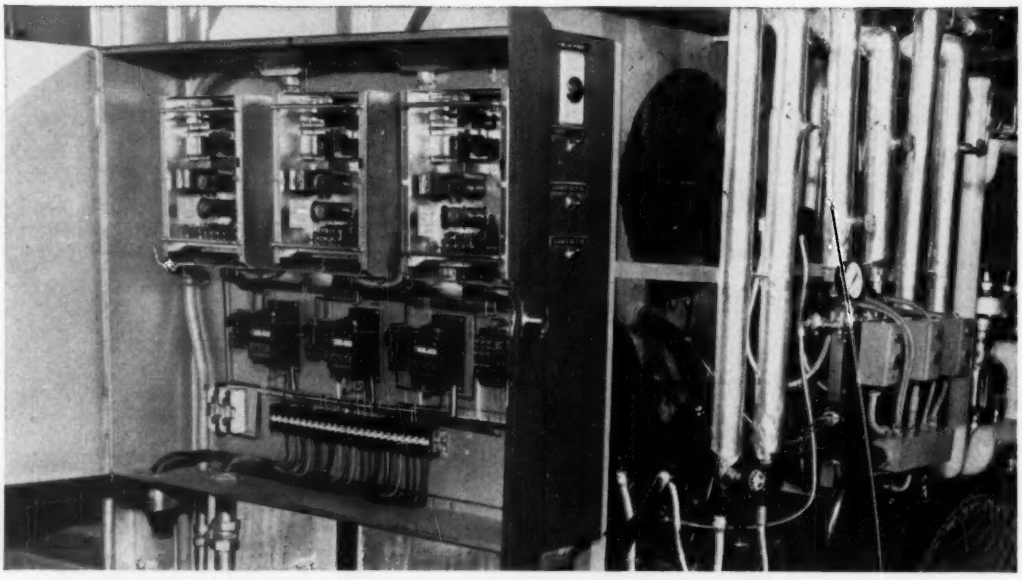
Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

CANADA: COMBUSTION ENGINEERING-SUPERHEATER LTD.

STEAM GENERATING UNITS; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; DOMESTIC WATER HEATERS; SOIL PIPE

a fireye Interlock System went in AFTER THE EXPLOSION...

Back Up Your Boiler Operator with Safeguards that



How FIREYE covers every step in the firing cycle —

PREVENTS hurrying or skipping steps essential to safe operation
PREVENTS light-off until combustion chamber and passages are purged clean
BLOCKS main fuel supply until pilot is proved at the right point for light-off
SHUTS OFF fuel if main flame does not stabilize within the trial-for-ignition period
SHUTS OFF fuel and sounds alarm if the flame goes out during the firing period

THE RESULT OF 1 SLIP

IN 15 YEARS OF PERFECT PROCEDURE

Cost of new boiler — $35,000 . . .
Cost of lost production — much more

FOR 15 YEARS a well-designed boiler and an experienced and thoroughly competent operator were enough for safety in this large New England plant. Of course, there was a "standard" type of burner safeguard present as well.

THEN, came one of the slips that prove no human is infallible. The operator attempted to light off a second burner from one already firing. The "safeguard" was too slow . . . there was a flash . . . the boiler was destroyed . . . production was shut down for months.

Protect Every Stage of Light-Off and Firing

Your boiler operator knows how great the need is for an assistant like Fireye. He knows that incorrect light-off or flame failure can occur in even the most modern burner installations. He knows that operators are only human, that they can slip. He is keenly aware that in an emergency no man can always act fast enough to avert disaster.

Fireye is the proved, complete, factory-integrated system that foresees and forestalls hazards of fuel burning in multiple-burner installations. With its Firetron "eye" that constantly monitors all stages of the firing cycle, Fireye acts within 2 to 4 seconds of the start of trouble. Its system of timers, interlocks, and shutoff valves automatically supervises every operating step.

The Fireye organization brings to your problems a knowledge and experience in fuel burning control that is without equal. It benefits you whenever Fireye engineers, located throughout the country, come in to survey your situation . . . supervise installation of Fireye equipment . . . check out the installation, and train your operating personnel.

Fireye alone can serve you so completely — and your need for its services may be greater than you realize. Begin TODAY, by mailing the coupon for your copy of a non-technical bulletin that explains why most fuel-burner explosions happen, and how Fireye prevents them.

E C A fireye

Other ECA Divisions: Photoswitch Division • Fireye Division • Marine Division • Business Machines Division • Photoconductor - Transistor Division • Military Division

Protect Your Boiler NOW — send for this

COMBUSTION CONTROL DIVISION • ELECTRONICS CORPORATION OF AMERICA
Dept. C9-2, 718 Beacon Street, Boston, Mass.
In Canada, write Electronics Corporation of America (Canada) Limited, Box 111, 98 Advance Road, Toronto 18.

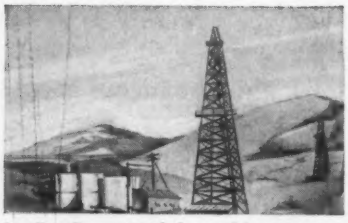
Send Bulletin CP21 on Flame Failure Explosions

NAME .....

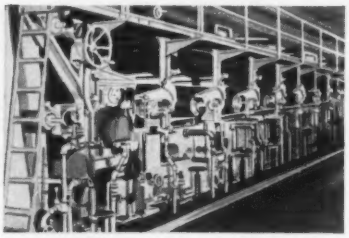
FIRM .....

ADDRESS .....

CELITE FILTRATION controls water purity— removes *all* suspended solids



In oil wells—output is boosted by repressurizing wells with water to force out accumulated oil. Celite Filtration purifies water to the extreme degree required—removes the minute suspended impurities which would otherwise clog the microscopic pores of sandstone.



In paper plants—Celite Filtration is used to purify the large quantities of water used in paper formation. Waste water may be filtered for reuse by the same process. Celite filter cakes can withstand many times the pressure of an ordinary filter bed. No pH control is necessary with Celite. *T.M. Reg. U.S. Pat. Off.

CELITE* FILTRATION provides the *right degree* of purity that you require for industrial process water. It removes sediment which may cause costly downtime or damage to expensive plant equipment. And if your application requires greater purity, Celite removes even such fine suspended solids as amoebae and algae, many of which cannot be filtered out by other methods. Moreover, fast, economical rates of flow can be maintained with Celite Filtration

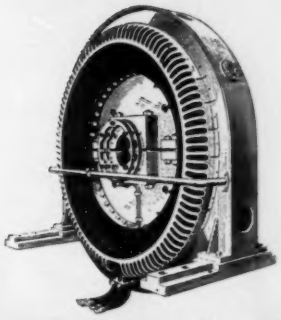
This selectivity in degree of water purity is made possible because Celite comes in nine standard grades . . . each designed to filter out impurities of specific size and type. Carefully processed from the purest deposits of diatomaceous earth, Celite always has utmost uniformity of product. Whenever you reorder, you are assured of the same accurately graded powder.

Celite Filtration offers many other advantages, too. Important space savings are achieved in the installation, longer filtration cycles are obtained, and less backwash water is required for cleaning the filters than with ordinary systems.

Celite Filtration provides pure process water for boiler make-up, heat exchangers, circulating water for towers . . . and many other industrial uses. It will pay you to investigate the advantages of Celite for your particular application. To have a Celite engineer study your problem and offer recommendations, simply write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville CELITE FILTER AIDS



HOW G-E SYNCHRONOUS MOTORS REDUCE MAINTENANCE COSTS

STATOR FRAMES FOR G-E LOW-SPEED SYNCHRONOUS MOTORS ARE WELDED WITH A CONTINUOUS DEEP FILLET WELD

Fabricated motor frames last longer!

G-E design engineers pioneered in developing welding techniques for fabricating low-speed synchronous motor frames. For many years they have felt this type of construction, combined with G.E.'s research and manufacturing skills, would produce motors capable of delivering long, highly dependable service in heavy-duty applications.

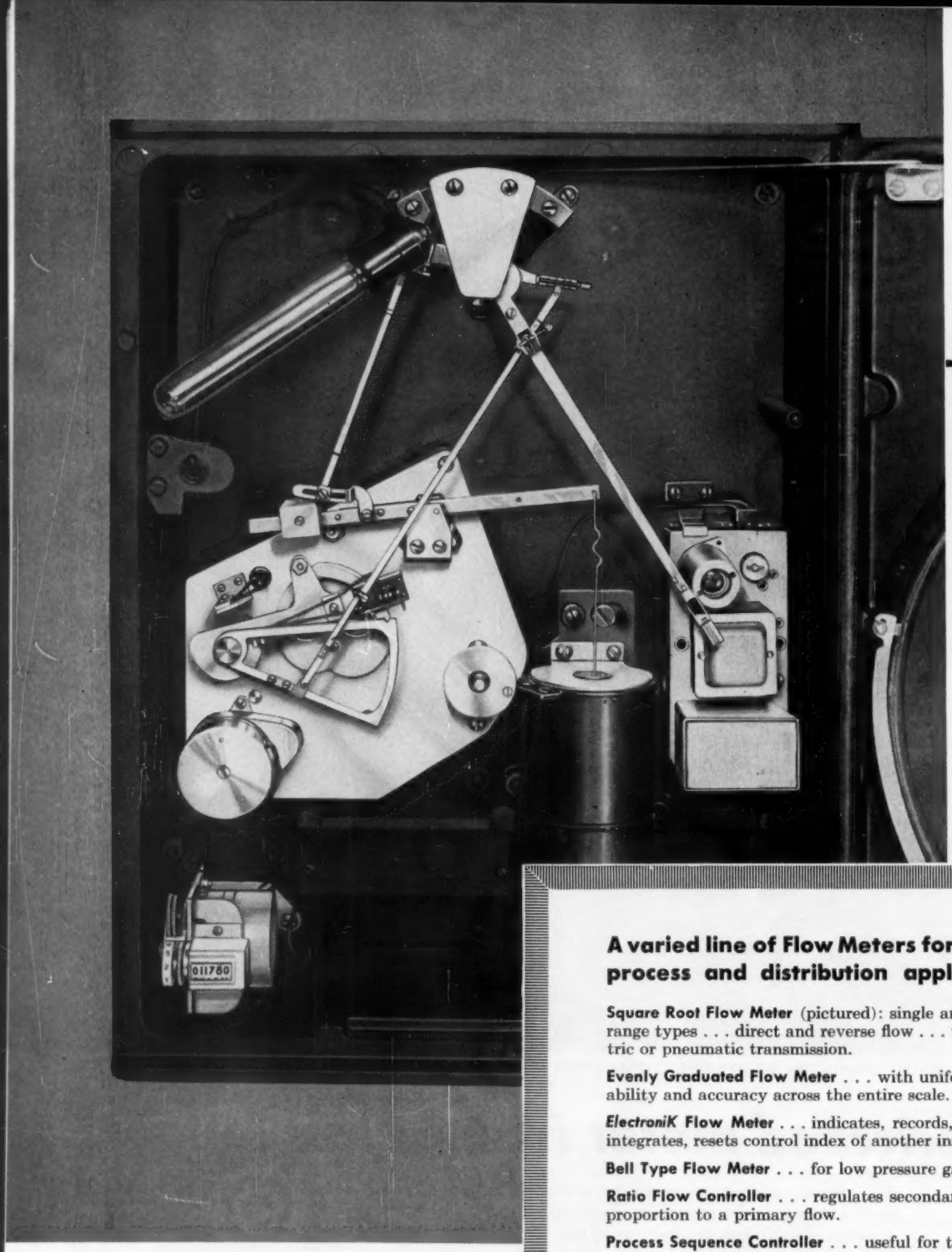
The results? After twenty years and millions of operating hours, welded steel frames have proved they make a tough, rigid motor. These G-E low-speed synchronous motors are giving service in such demanding installations as pulp grinders, air compressors, wood chippers, ball mills, jordans and rolling mills.

These motors have shown they can better withstand the severe operating conditions of such installations. This means you save money by avoiding costly downtime.

The next time you consider a synchronous motor drive, contact the nearest G-E Apparatus Sales Office. A sales engineer will be glad to explain the many advantages of G-E equipment. Or, if you prefer, write for GEA-5332, "Low-Speed Synchronous Motors." Address Section 770-39, General Electric Co., Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC



A varied line of Flow Meters for every process and distribution application

Square Root Flow Meter (pictured): single and double range types . . . direct and reverse flow . . . with electric or pneumatic transmission.

Evenly Graduated Flow Meter . . . with uniform readability and accuracy across the entire scale.

***ElectroniK* Flow Meter** . . . indicates, records, controls, integrates, resets control index of another instrument.

Bell Type Flow Meter . . . for low pressure gases.

Ratio Flow Controller . . . regulates secondary flow in proportion to a primary flow.

Process Sequence Controller . . . useful for timing the addition of reagent to a preset cycle.

Parshall Flume Meter . . . for measuring flow in open channels and weirs.

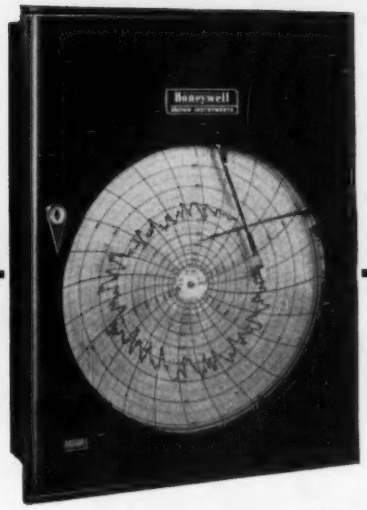
***Tel-O-Set* Miniature Instruments** . . . for graphic panels and other applications where space is at a premium.

Area Flow Meter . . . electric meter body for use with viscous fluids.

Differential Converter . . . the mercuryless flow transmitter with high sensitivity, precision and rangeability.

▲ *Reference Data:*

Write for Catalog 2321, "Flow Meters, Indicating, Recording, Integrating, Controlling."



The Brown Flow Meter line

was designed for your process applications

An important reason why Brown flow meters give you better performance is that they were designed specifically for flow recording, integration and control in industrial processes. Far from being step-children of boiler plant instruments, they embody features that fit the needs of modern production technology. Their design has been refined and perfected throughout 28 years of experience in flow instrumentation . . . to assure you of the utmost in precision, versatility and reliability.

For measurement, Brown Flow Meters give you a complete range of meter bodies to work with any fluid at any pressure . . . either electrical or pneumatic transmission . . . and the flexibility of interchangeable range tubes.

For integration, Brown Flow Meters feature accurate, simple electronic flow integration, in a design that places no mechanical load on the measuring mechanism.

For control, Brown Flow Meters, particularly those with square root calibration, offer an unequalled variety of control actions to match the needs of the simplest to the most complex process requirements.

For service, Brown Flow Meters give you basically simple and rugged designs that cut maintenance to the minimum . . . plus the convenience of prompt assistance in start-ups, routine maintenance and emergencies, by Honeywell specialists located near your plant.

Ask your local Honeywell sales engineer to discuss your flow applications. He's well qualified to give competent consultation . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

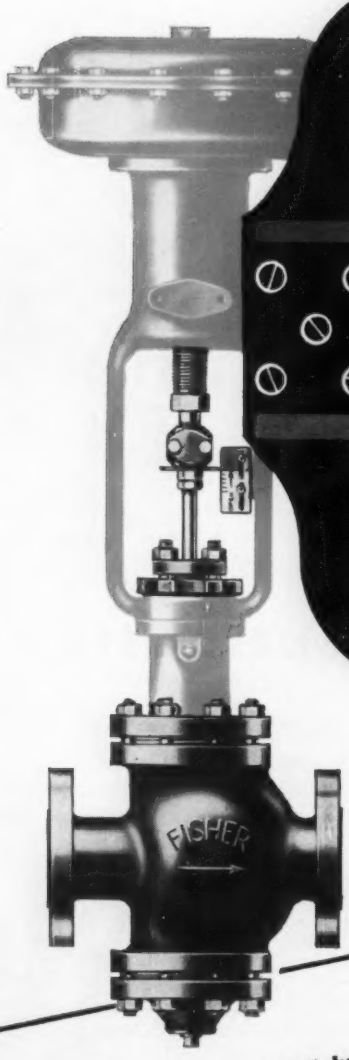
MINNEAPOLIS **Honeywell**

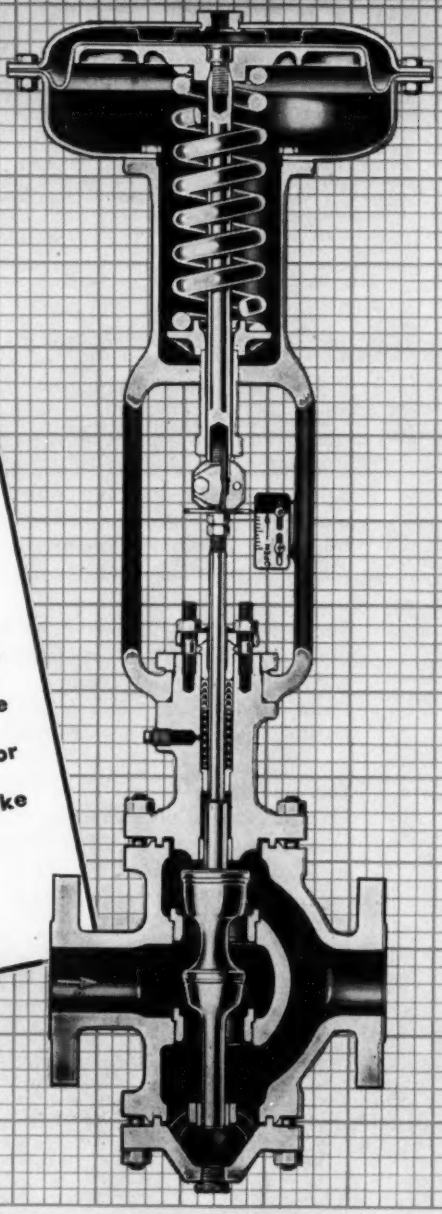
BROWN INSTRUMENTS

First in Controls

FISHER®

DIAPHRAGM





● **Fisher Diaphragm Motor Valves are furnished in a wide variety of pressure ratings and materials. Topworks may be either direct acting (Series 657) or reverse acting (Series 667). Handjacks are available for either diaphragm casing mounting or yoke mounting. There are six diaphragm and yoke size combinations.**

Improved

MOTOR VALVES

Improved PERFORMANCE FEATURES

- Bolted-clamp type stem connection allows stem adjustment of 50% of total travel. Can be disconnected in the field without stem damage. Will not shake loose from vibration or rotational inner valve forces.

- Rugged body to yoke connection with hammer lug nut. Topwork can be removed without disturbing stuffing box.

- Specially designed Buna N molded diaphragms with Nylon insert retain superior flexibility at low ambient operating temperatures. Provides linearity between operating pressure signal and travel, and gives maximum effective area.

- Bolted gland stuffing box with Teflon packing.

- Stainless steel clear view travel indicator.

- Spring ranges: 3 to 15 psi; 6 to 30 psi.

FISHER GOVERNOR COMPANY • Marshalltown, Iowa

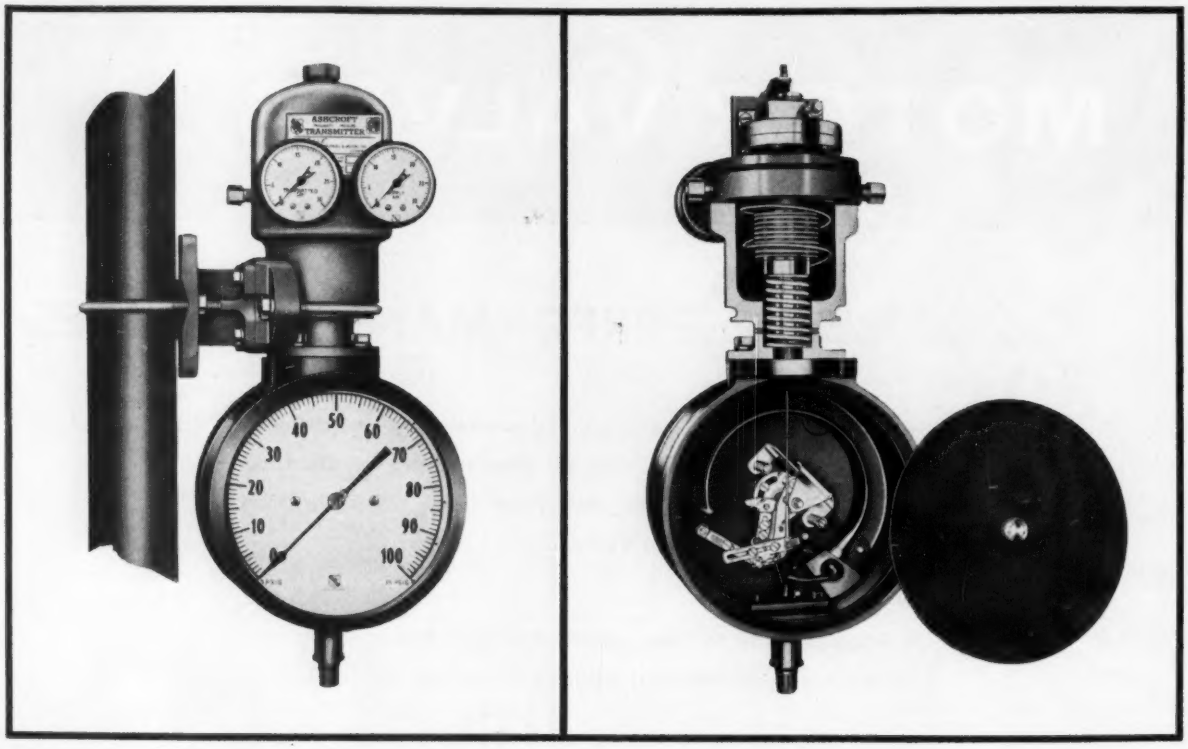
WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

FISHER

Since 1880

Designed to solve safety and service problems

...THE NEW ASHCROFT PNEUMATIC PRESSURE TRANSMITTER



This new Ashcroft Pneumatic Pressure Transmitter is particularly recommended to processing industries and power stations. It combines speed and accuracy with maximum protection and serviceability.

The new design features the 6" indicating Ashcroft Maxisafe Duragauge, long known for dependable performance. It has an integrally-cast solid metal wall between dial and pressure sensitive element so that the transmitter can measure pressures up to 100,000 psi with complete safety for personnel and equipment. If misapplication ruptures the Bourdon tube, the Teflon-coated back cover serves as a safety blowout relief.

Another outstanding design advantage is easy access to both gauge and transmitter sections. Simply remove the safety-relief back cover and both the gauge and transmitter can be calibrated. Yet a sealed housing makes the entire assembly weatherproof.

The transmitter operates on low-pressure air. No need for expensive high-pressure lines and fittings. Supply air pressure as low as 18-20 psi for 3 to 15 psi output provides especially advantageous operation where electrical wiring might be a hazard. Inflammable, poisonous or corrosive liquids or gases are confined close to their source, away from the central control point.

The Series 1250 Ashcroft Pneumatic Pressure Transmitter is available with pressure sensing elements in all standard pressure ranges and Bourdon tube materials. Installation of the transmitter is easy. Small diameter tubing may be used, and the pipe, stem, wall or flush mounts are interchangeable in the field. Get complete operational data and construction details. Write for Bulletin 340.

1850 ASHCROFT U.S.A.

MAXWELL MANNING & MOORE INC. TRADE MARK

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR has the broad knowledge and thorough experience essential to satisfy every requirement of your Ashcroft Pneumatic Pressure Transmitter application. You get fast, economical service from his local stocks.

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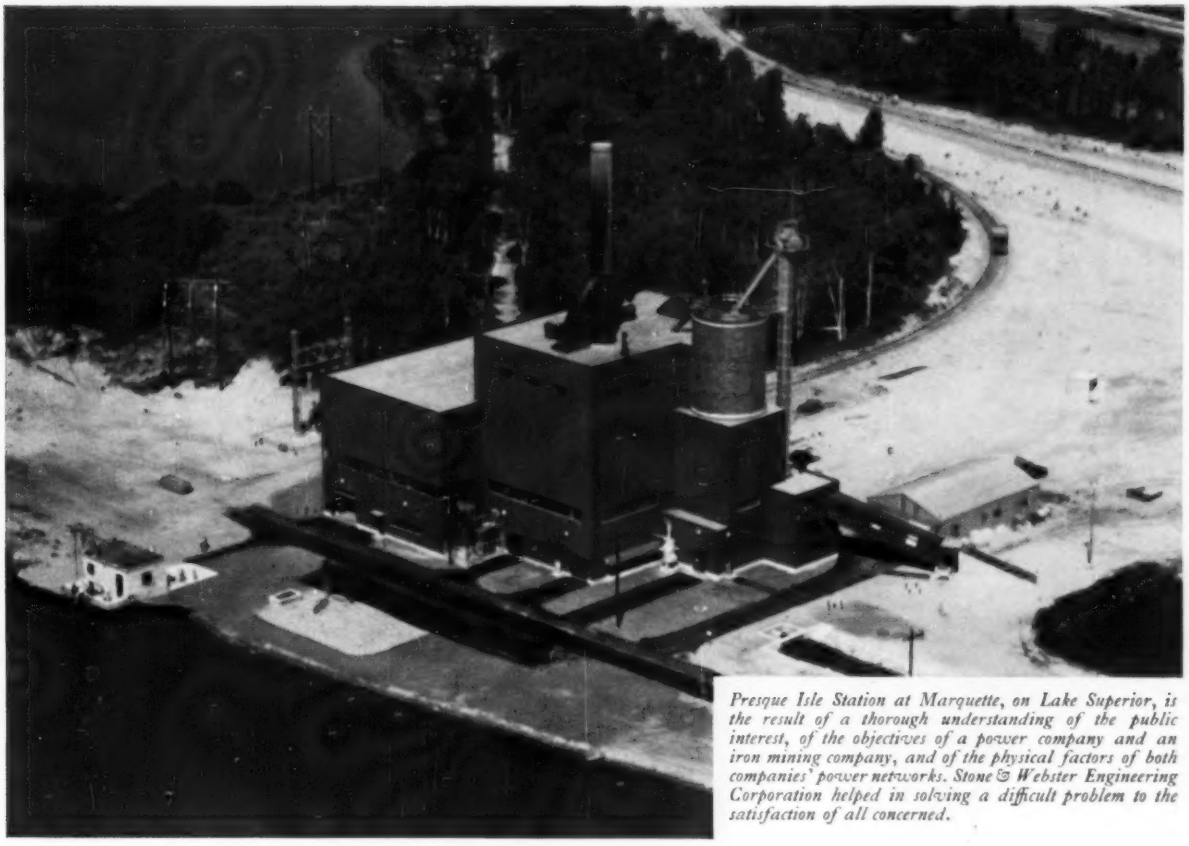
ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*



Presque Isle Station at Marquette, on Lake Superior, is the result of a thorough understanding of the public interest, of the objectives of a power company and an iron mining company, and of the physical factors of both companies' power networks. Stone & Webster Engineering Corporation helped in solving a difficult problem to the satisfaction of all concerned.

SOLVING THE POWER PROBLEMS ON MICHIGAN'S UPPER PENINSULA

To meet the critical demand for more power in Michigan's Upper Peninsula region, the Upper Peninsula Power Company and The Cleveland-Cliffs Iron Company retained Stone & Webster Engineering Corporation to assist in their separate expansion programs.

As a result of intensive studies and investigations of all aspects of the situation by the Engineering Corporation, it was decided to build a single jointly-owned steam power plant. Presque Isle Station was designed and built by the Engineering Corporation and is now on the line with initial installation of 22,000 kilowatts.

If you have a problem of design or construction, our broad experience in these and related fields may help you solve it. Write or call us for complete information on our services.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

New York Boston Chicago San Francisco Los Angeles Houston Pittsburgh Seattle Toronto

PRE-TESTED!

CHASE® ANTIMONIAL ADMIRALTY CONDENSER TUBES

are made to last years longer!

All the hydrostatic tests, corrosion tests, expansion and flattening tests which go on at the Chase mills are designed for one thing—to assure *years* of extra service from Chase Antimonial Admiralty Condenser Tubes.

But the real test takes place right on the job—where stresses, strains and corrosion are at their very worst. Chase Antimonial Admiralty Condenser Tubes pass *that* rugged trial with flying colors!

It follows that the longer condenser tube life you get from Chase Antimonial Admiralty *also* means lower operating costs, fewer breakdowns and more time between tube replacements!

Get the benefit of extra years of service—insist on Chase Antimonial Admiralty!

Chase®

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Prompt Delivery from Cleveland and Waterbury Mills

The Nation's Headquarters for Brass & Copper

Atlanta	Chicago	Denver	Indianapolis	Minneapolis	Philadelphia
Baltimore	Cincinnati	Detroit	Kansas City, Mo.	Newark	Pittsburgh
Boston	Cleveland	Grand Rapids	Los Angeles	New Orleans	Providence
Charlotte	Dallas	Houston	Milwaukee	New York	Rochester
	St. Louis	San Francisco	Seattle	Waterbury	

FOSTER WHEELER ANNOUNCES A

COMPLETELY NEW

COOLING TOWER

...designed for FASTER ERECTION
and LONG-RANGE ECONOMY

Here are some of its outstanding new features:

Water-Mizer Drift Eliminators, assembled in racks, engineered for maximum efficiency. Drift losses held well *below* recommended minimum values.

Full Cone Spray Nozzles provide maximum dispersion with exceptionally low pressure drop. Spray pattern remains excellent for any overload and for at least 30% below design flow.

3'x6' Double Diamond Fill Racks utilize heavy stringers and 1" lath spaced in a diamond pattern, affording rigidity while minimizing pressure drop.

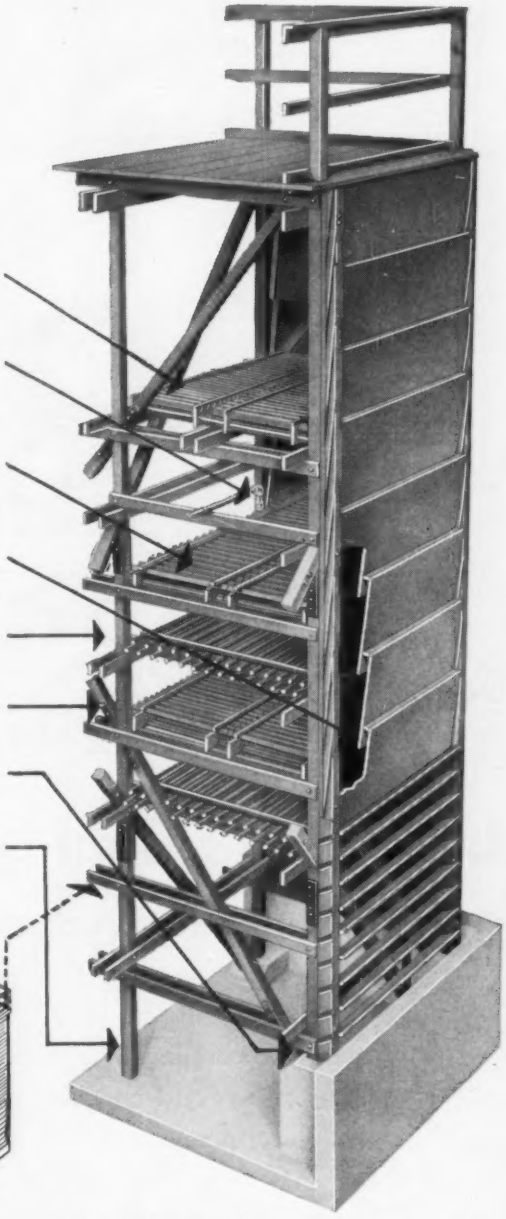
Double Lapped Sheathing Panels provide the water-tight advantage of double-wall construction yet avoid stagnant air spaces and prevent wood attack. Panels are pre-assembled to cut erection time.

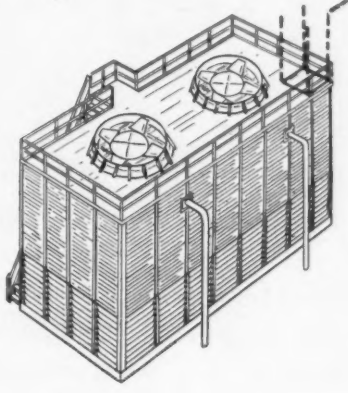
Redwood Framing, structurally redesigned to 6'x6' bays, to provide maximum rigidity and conservative loading of all members.

Simple, Straight-Line Bracing eliminates all eccentric joints and relieves structural members of horizontal shearing and bending stresses.

Simple Clevis Anchors are used on the diagonals, not the posts. Require only one foundation bolt per anchor.

Self-Leveling Interior Posts cut to fit basin floor — compensate for irregularities in level and eliminate need for pads or grouting.



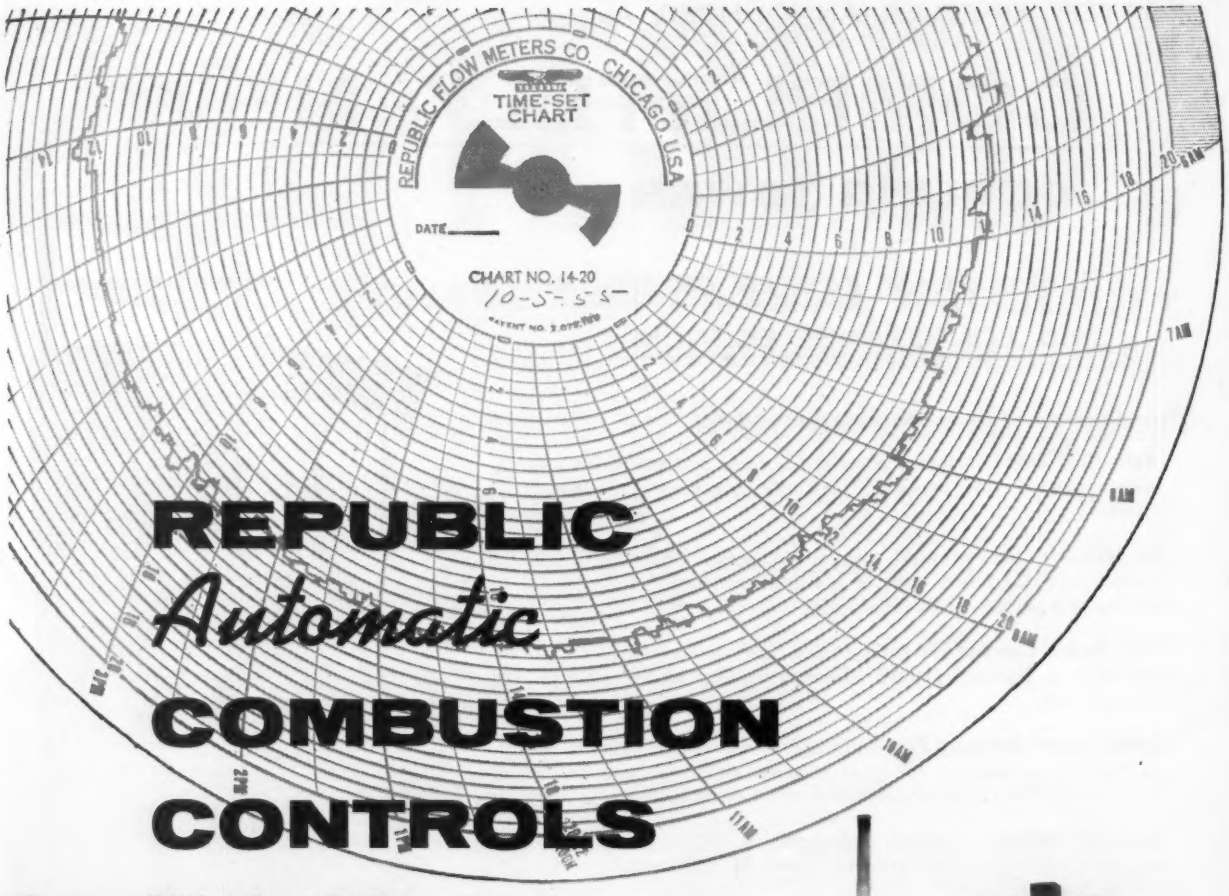


THESE are just a few of the many advantages designed into the new Foster Wheeler Cooling Towers. Built of decay-resistant California redwood throughout, this induced-draft counter-flow tower represents an important advance in cooling tower design. Ask your FW representative to give you complete details — or send for additional information. *Foster Wheeler Corporation, 165 Broadway, N. Y. 6, N. Y.*

Detail drawing of a single corner bay of the new Foster Wheeler Induced Draft Cooling Tower. Lower fill racks have been omitted to show structural details to better advantage.

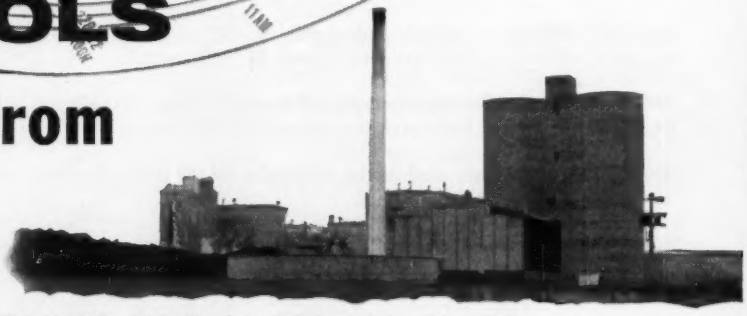
FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.



REPUBLIC *Automatic* COMBUSTION CONTROLS

Get High CO_2 from Low Grade Coal



at UTAH-IDAHO SUGAR COMPANY'S NEW $7,000,000 PLANT

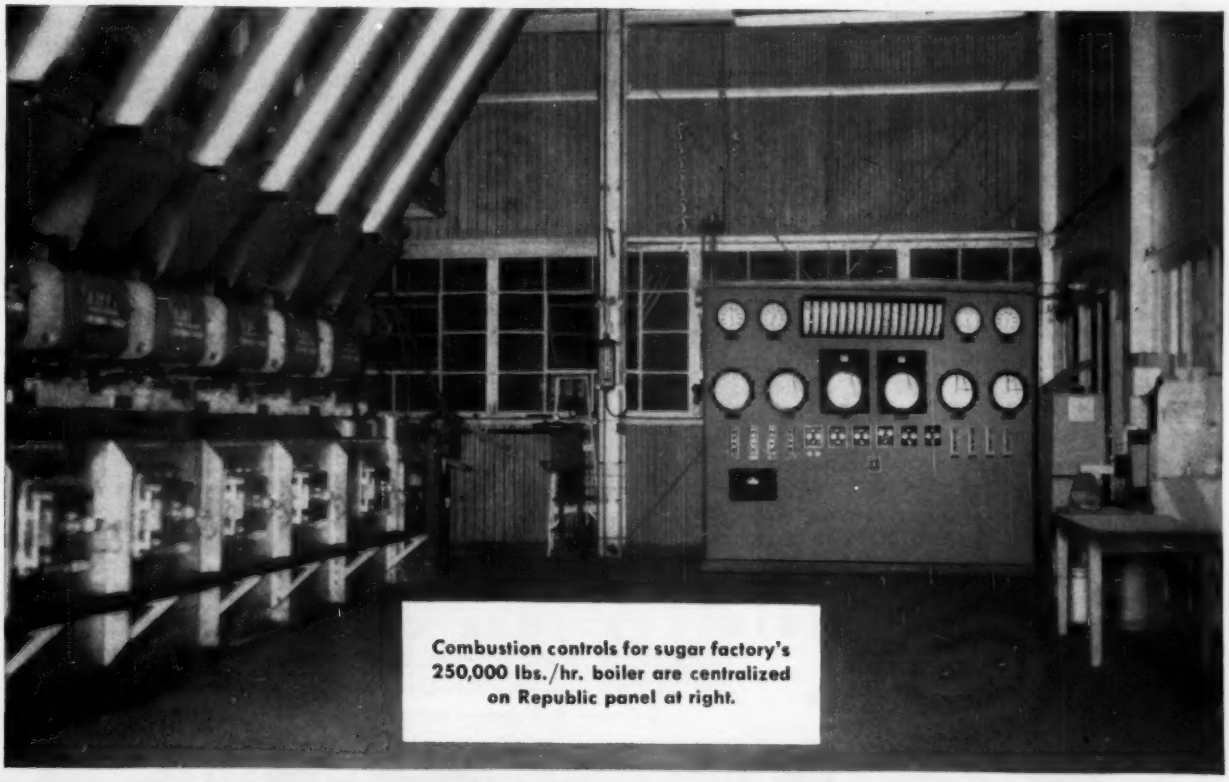
In any power plant, the percentage of CO_2 in combustion gases is indicative of combustion efficiency. But at the power plant for Utah-Idaho Sugar Company's new sugar beet factory, Moses Lake, Washington, a good CO_2 performance record is more than desirable. It's actually essential! That's because the plant supplies not only steam, but CO_2 as well to sugar-making processes. The CO_2 is extracted from combustion gases and becomes a vital ingredient in the production of over 75,000,000 lbs. of sugar and thousands of tons of molasses the factory produces annually. With the plant limited to low grade western coal, continuous maximum combustion efficiency at all loads is necessary to insure adequate CO_2 for processes.

Republic Automatic Combustion Controls enable the plant's spread stoker fired 250,000 lbs./hr. boiler

operating at 400 psig and 575°F. to meet CO_2 requirements while matching steam supply to process demands. Daily CO_2 charts indicate the boiler is consistently producing 12–13% CO_2 in spite of the quality of coal burned.

According to operators, ash removal, cleaning of the fire and soot blowing can be carried out with the combustion controls on automatic without disturbing the fuel-air ratio. Furnace draft is controlled satisfactorily despite the high stack on the plant. Turbine drives on forced and induced draft fans are speed controlled by the combustion controls, eliminating the need for dampers. A three element Republic boiler feedwater system is also tied in with the combustion control system to automatically supply the proper amount of water to the boiler at all steaming rates.

This plant is one more example of how Republic combustion engineers design control systems that enable boilers to exactly meet individual plant requirements. There are Republic Combustion Controls for any size or type of boiler, for all methods of fuel firing, all arrangements of draft and all load conditions. When you want to be sure of getting maximum boiler performance, ask Republic to design and build your combustion control system.



Combustion controls for sugar factory's 250,000 lbs./hr. boiler are centralized on Republic panel at right.

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois

Building Water Treatment Systems *is a man-size job!*

Having been in the water conditioning business for nearly fifty years, we know that *every* water treatment job is a challenge. In this business, you can't send a boy to do a man's work.

Since 1908, Elgin has been designing, building and installing water conditioning equipment for thousands of purposes in hundreds of industries, institutions, municipalities and commercial establishments. Naturally, during that time, we've built up a backlog of experience and water engineering skill second to none. As a result, the name *Elgin* has become synonymous with superiority in the field of water conditioning — whether softening, dealkalizing, demineralizing, deaeration, degasification, chemical treatment.

Elgin makes it a policy to meet *every* water treatment problem with concentrated attention. You can feel sure — when you bring your problem to us — that all the experience and knowledge at our command will be at your disposal. Talk over your water treatment problems with your Elgin representative. Or write us direct. We *can* help you!

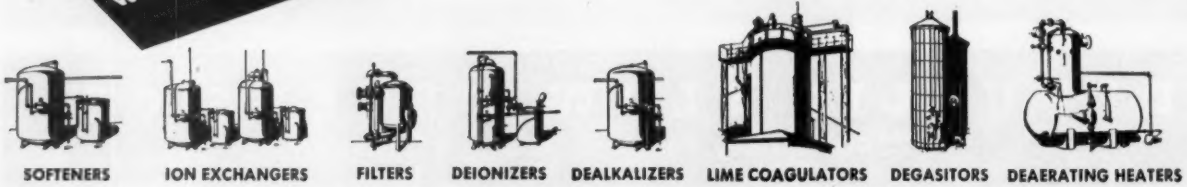
ELGIN WATER CONDITIONING SINCE 1908

ELGIN SOFTENER CORPORATION

130 No. Grove Avenue, Elgin, Illinois

Representatives in Principal Cities

In Canada: G. F. Sterne & Sons Ltd., Brantford



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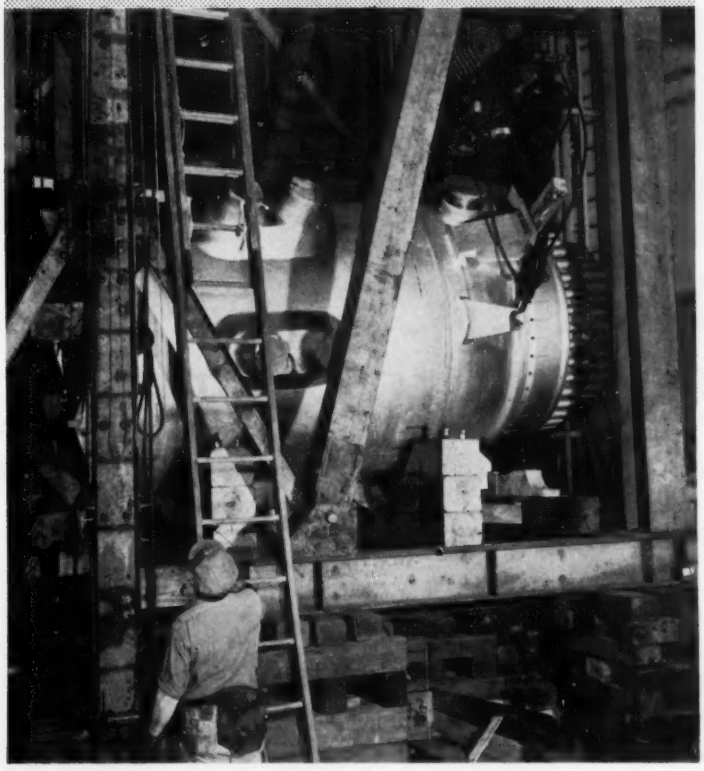
Eichleay... *and the Atomic Age*



The job of unloading, handling and installing the 'Bettis Test Facility' and associated equipment at the Atomic Energy Commission's Bettis Plant, operated by Westinghouse Electric Corporation, called for a degree of skill, precision and finesse seldom encountered in the construction field.

The construction of this equipment made it difficult to handle in a normal manner due to the danger of placing undue stresses on a machine designed to such a high degree of precision. The installation called for tolerances seldom encountered in the construction field and attained only by the use of instruments normally used by physicians and skilled technicians.

Eichleay Corporation with its vast experience in the handling of complex problems made the installation with its usual efficiency and without incident.

Thru the Bettis Test Facility Westinghouse was able to complete development work critical to the "Nautilus" power plant.

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Industrial Installations
Construction of Heavy Foundations
Building and Machinery Moving
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ESTABLISHED 1875

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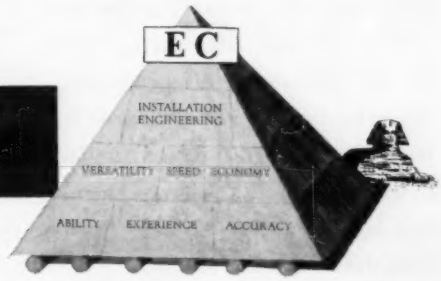
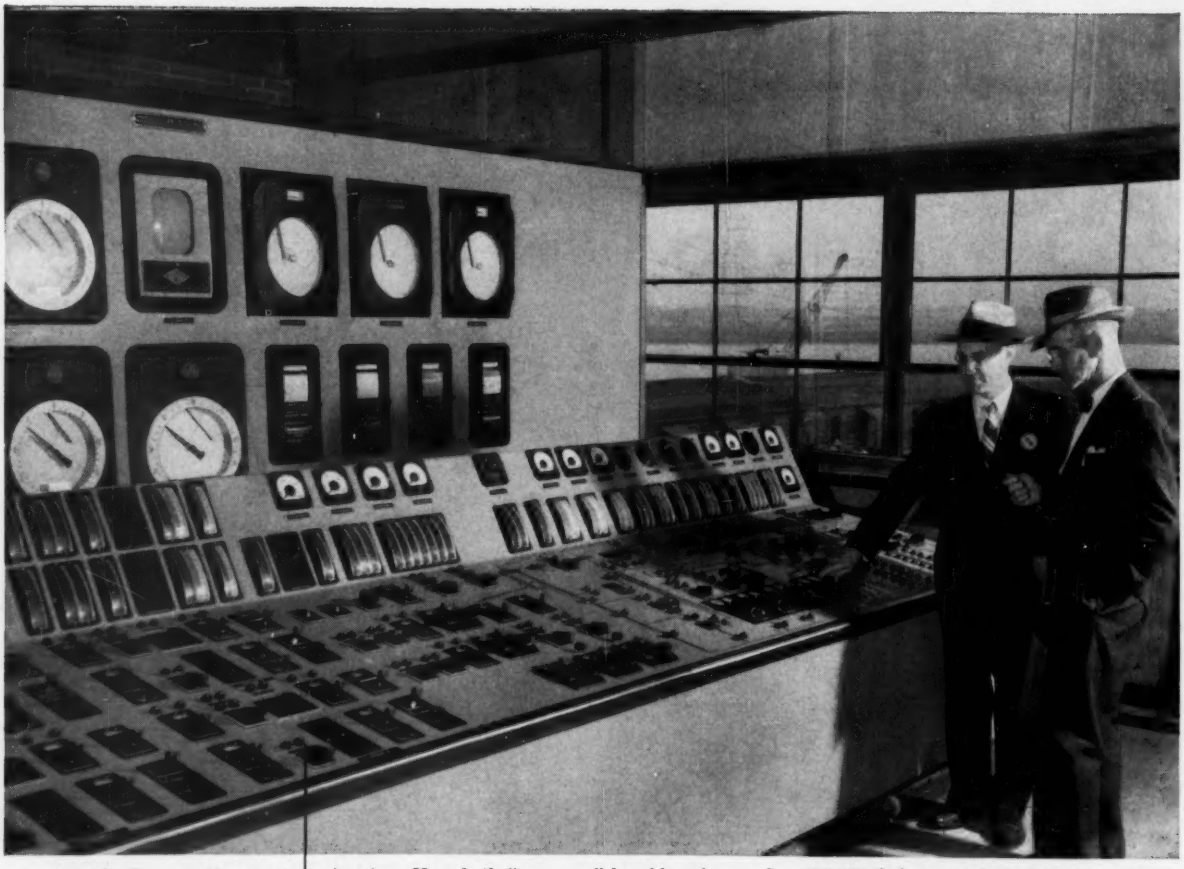




At Jersey Central Power and Light

A unique Hays built "two story" benchboard controls a 900,000 lb/hr multiple fuel fired boiler. Necessary control stations and miniature indicators are consolidated in a small space for one man operation, yet are easily accessible from inside the panel for servicing.

NEW DIMENSIONS IN COMBUSTION CONTROL

Dramatic results are being achieved by the nation's top

Today's boiler plant is only as efficient as the instrumentation which operates it. In selecting the correct equipment to assure completely automatic operation, to provide cost reductions through labor saving, and greater efficiency, the companies shown on these pages have looked to Hays. The newest in power plant design coupled with Hays workmanship and follow-through have given them the results they sought.

SKILLED FACTORY ENGINEERING

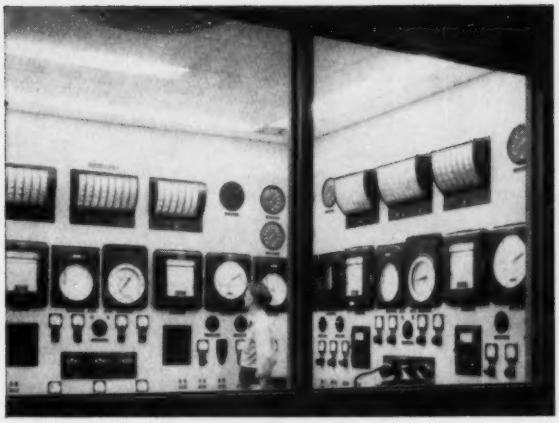
Hays systems are engineered to your specific requirements by a staff of specialists with years of experience on hundreds of boiler plants from the smallest to the largest. The particular instrument and control "package" necessary to handle your conditions is selected from the Hays product line; panel design, complete wiring, conduit, piping and control system diagrams are closely checked to see that they fit your requirements.

NATIONWIDE SERVICE

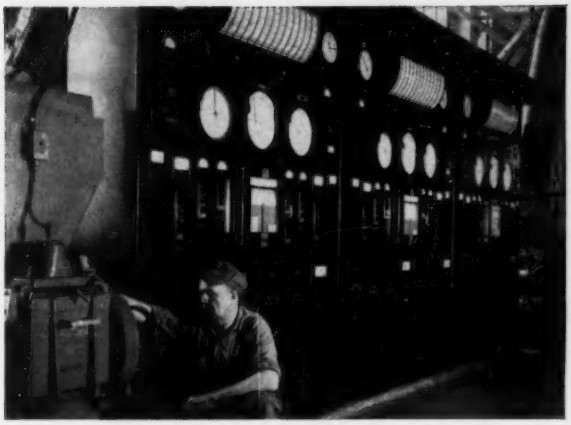
Service on Hays products is available throughout the country. Trained service engineers, from the factory or from Hays representatives in principal cities, can provide "start up" calibration and adjustment as well as subsequent periodic preventive maintenance service on your equipment.

For best results you will want to confer with Hays Sales Engineers in the earliest stages of your planning.

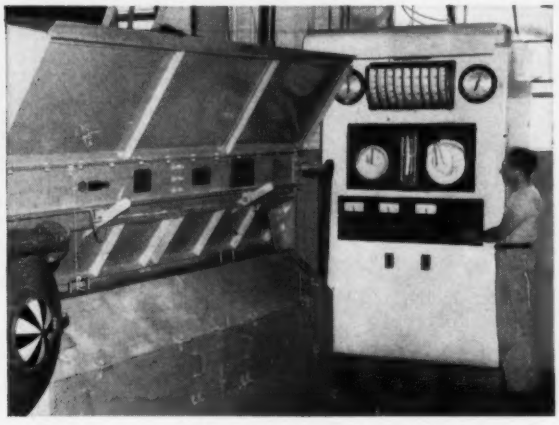
Write for complete information. Bulletin 55-605-83.



At Northern Indiana Public Service, the Hays system permits any desired allocation of load among three boilers, between the two cyclone furnaces of a given boiler and between the two fuels (coal and gas) being burned simultaneously in a given cyclone.



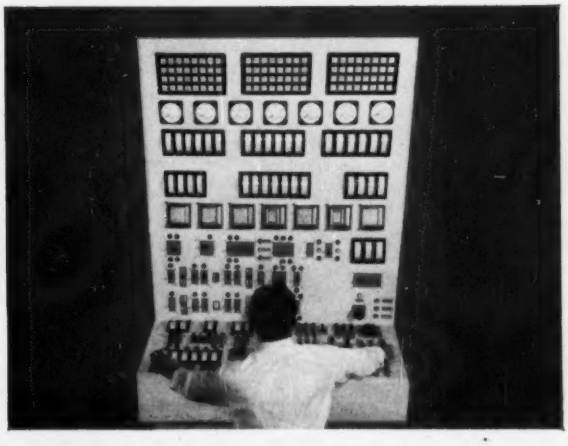
At Baldwin Locomotive Works, the Hays combustion control has aided substantially in saving 30,000 tons of coal per year and in reduction of maintenance. It is now possible to operate the power plant with 42 less men.



At Falstaff Brewing Corporation, modernization and Hays metering type control have resulted in boiler efficiency of 82%, fuel cost reduction of several hundred dollars per month, CO_2 up from 6% to 12%, and maintenance costs lowered 65%.

At Morton Salt Company, Manistee, Michigan, the fact that electricity doesn't freeze is vital in this semi-outdoor boiler which handles load swings up to 80,000 lb/hr at 85% efficiency with help of Hays electrically operated combustion control system.

utilities and manufacturing companies



At Louisiana Power and Light, a compact Hays B. T. G. control panel only 4 feet wide controls a giant 1,000,000 lb/hr boiler, turbine and generator! Instrumentation and control by Hays includes new electronic mercuryless flow meters and other electronic instruments for greater speed and accuracy.

THE **hays** CORPORATION

MICHIGAN CITY 3, INDIANA

Automatic Combustion Control • Veriflow Meters and Veritrol • Electronic Oxygen Recorders • CO_2 Recorders Boiler Panels • Gas Analyzers • Combustion Test Sets Draft Gages • Electronic Flowmeters • Miniature Remote Indicators • Electronic Feed Water Controls

Here's where you get the answers to pipe problems

● Look under "The Youngstown Sheet and Tube Company" in one of these alphabetical or classified phone books.

They represent the 28 conveniently located district sales offices Youngstown maintains across the country. Offices staffed by men who are specialists in steel and who know pipe. They understand **your** problems and are qualified to help you get the pipe you need.

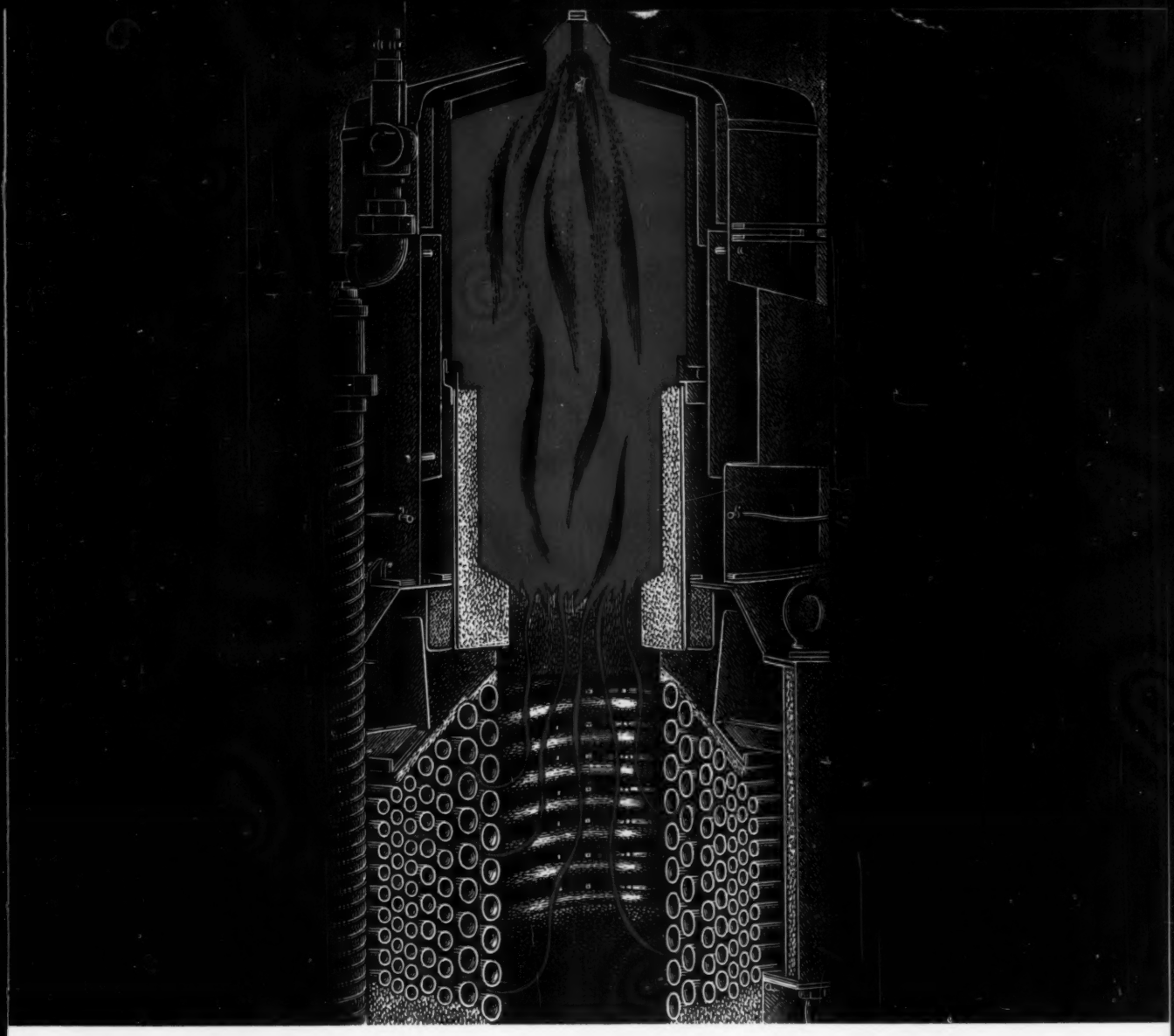
If you aren't in touch now with a Youngstown pipe distributor, just call the Youngstown district office nearest you and we will help you solve your pipe problems.

QUALITY YOUNGSTOWN SERVICE

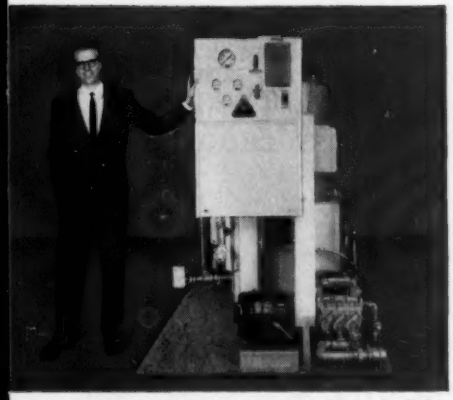
THE YOUNGSTOWN SHEET AND TUBE COMPANY *Manufacturers of Carbon, Alloy and Yoloy Steel*

General Offices Youngstown, Ohio District Sales Offices in Principal Cities.

SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - BLACK PLATE - RAILROAD TRACK SPIKES - MINE ROOF BOLTS



more steam, faster steam in less space



See how small, how compact, 100 h. p. can be!

Water, force-circulated through a Modulātic Steam Generator, absorbs heat more thoroughly because of splitting gasses into thin wiping films over many uniquely spaced heat-transfer surfaces. This unique spacing is a result of Vapor's exclusive water-tube design.

This provides more steam from much smaller boiler rooms in new plants—makes possible addition of steam in already crowded plants. The entirely self-contained, fully automatic Modulātic unit can be moved through existing doorways and installed in unused corners or other out-of-the-way spaces.

It's time to take a new look at steam-making progress—at what today's remarkable water-tube Modulātic will mean to you in new time and money economies. In Canada, write Vapor Car Heating Co. of Canada, Ltd., 65 Dalhousie St., Montreal 3.

MODULĀTIC

VERTICAL STEAM GENERATOR

Proved for 23 years in the toughest boiler rooms in America

VAPOR HEATING CORPORATION
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Please send me free 12-page Modulātic Bulletin No. 586.

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70 Years ago we used ads like this to tell buyers about Bell & Zoller Coal. We've done a lot of growing—and made a lot of changes since then. • But one thing hasn't changed—the famous free-burning, low ash, high heat-producing quality of Bell & Zoller products. • The proudest statement we can make on our 70th Anniversary is the same one we could make in 1886: Superb Quality Coal, We Mine It—ZEIGLER, MOSS HILL, ORIOLE, MURDOCK, LIBERTY SMOKELESS, BUCKHORN, SPARTA... and you can get it today through your nearest Bell & Zoller office.

Bell & Zoller Coal Company

70 YEARS OF SERVICE TO COAL USERS

BELL BUILDING, CHICAGO 1, ILLINOIS

Cleveland • New York • St. Louis • Minneapolis
Omaha • Milwaukee • Louisville • Washington, D.C.
Terre Haute, Ind. • Mount Hope, W.Va.

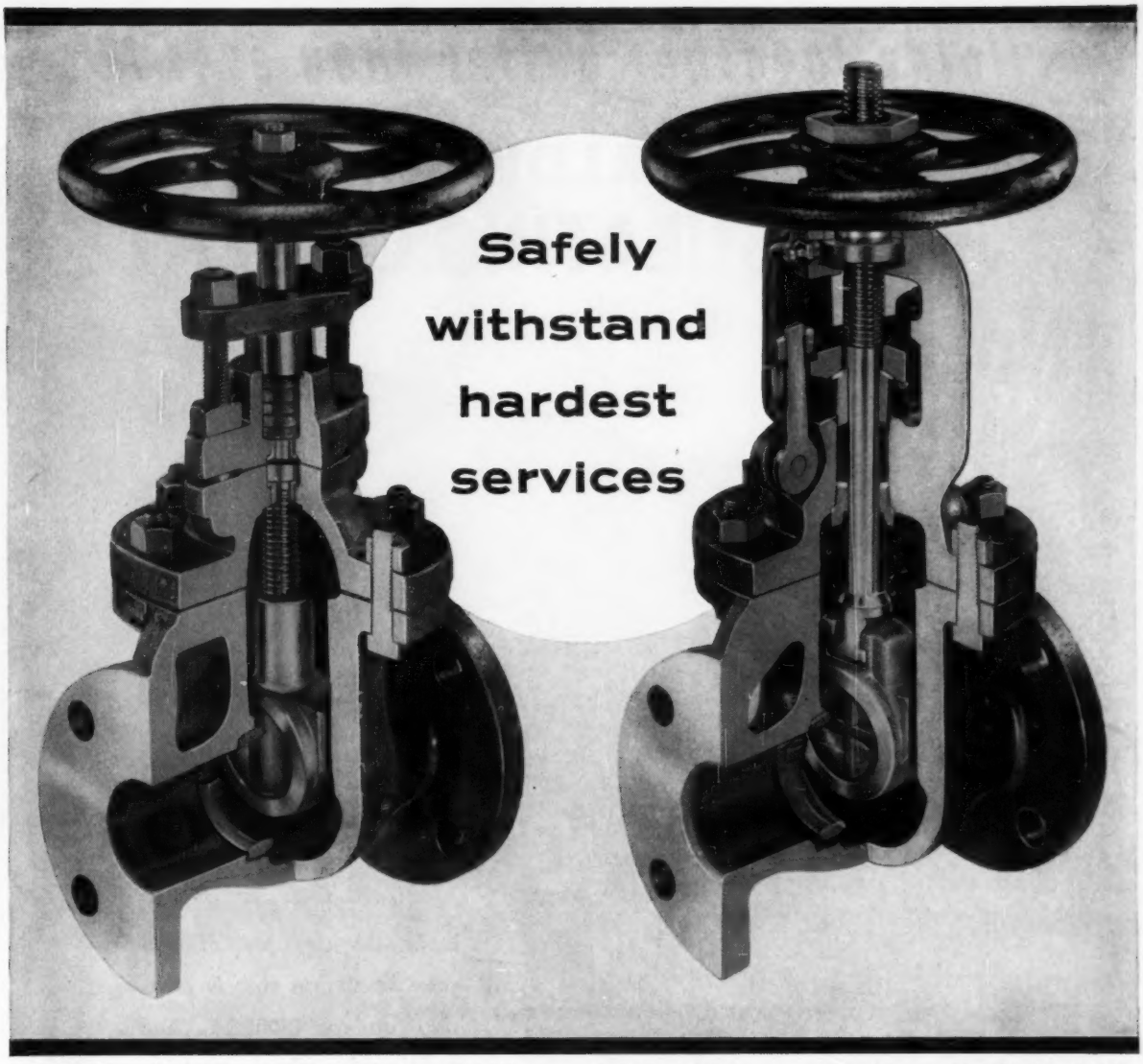


Fig. 1138 (left) non-rising stem, Fig. 1140 (right) OS&Y... two of 29 OIC iron valves with steel valve features. Metals used for trim and pressure parts in this line include: bronze, manganese bronze, nickel-plated steel, higher strength iron, nickel-alloyed iron, Monel, 18-8 stainless, 11-½-13 chrome.

Reduce valve wear. Choose from 29 OIC iron valve numbers with 9 different trim and body metal variations. Depend on them for general use and process industry services handling alkaline liquors, creosote, sour crude, sulphuric acid and caustics.

Working parts design assures positive seating . . . long life

Seat rings are end seated, reducing the probability of loosening in service and affording streamlined flow from port to port. Body wedge guides and a flexible T-head stem-wedge connection combine to assure accurate wedge seating for tight shutoff.

Extra strength adds safety to pressure parts

High-strength iron castings assure pressure parts made to a minimum tensile strength of 31,000 psi. The body and bonnet, elliptical in shape, resist internal pressure with least possible distortion. Body-bonnet bolting provides uniform gasket loading and, consequently, a pressure-tight seal throughout the pressure range of the valves. Tie ribs, cast between the pipeline flange and the body bonnet flange, prevent distortion from excessive pipeline stresses.

This line's many added features, trim variations, dimensions and end openings are completely described in the new OIC specification folder, Form No. 1005. Write for it.

Order valves from your OIC Distributor.

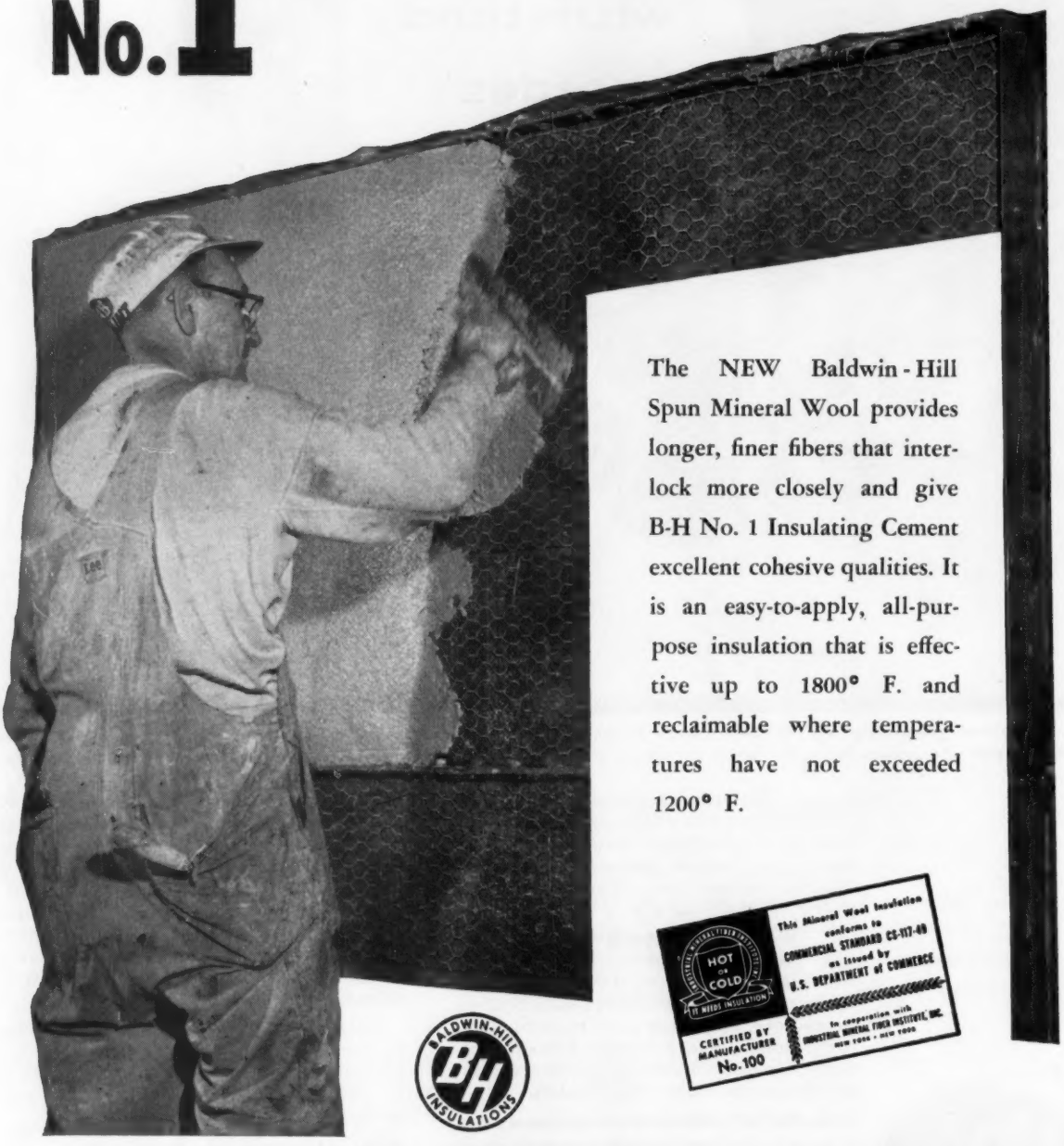
OIC
FOUNDED 1883

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

VALVES | **FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON VALVES**

Holds together better than ever . . .

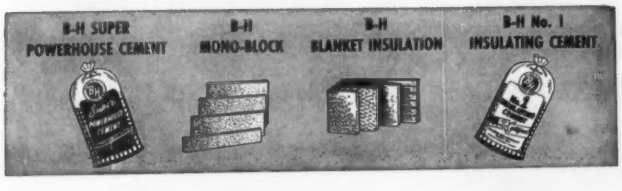
BALDWIN-HILL
No. 1 INSULATING CEMENT



The NEW Baldwin-Hill Spun Mineral Wool provides longer, finer fibers that interlock more closely and give B-H No. 1 Insulating Cement excellent cohesive qualities. It is an easy-to-apply, all-purpose insulation that is effective up to 1800° F. and reclaimable where temperatures have not exceeded 1200° F.

HOT or COLD
IT NEEDS INSULATION
This Mineral Wool Insulation conforms to COMMERCIAL STANDARD CS-117-49 as issued by U.S. DEPARTMENT of COMMERCE
In cooperation with INDUSTRIAL MINERAL FIBER INSTITUTE, INC.
CERTIFIED BY MANUFACTURER No. 100

BALDWIN-HILL INSULATIONS



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COMPANY
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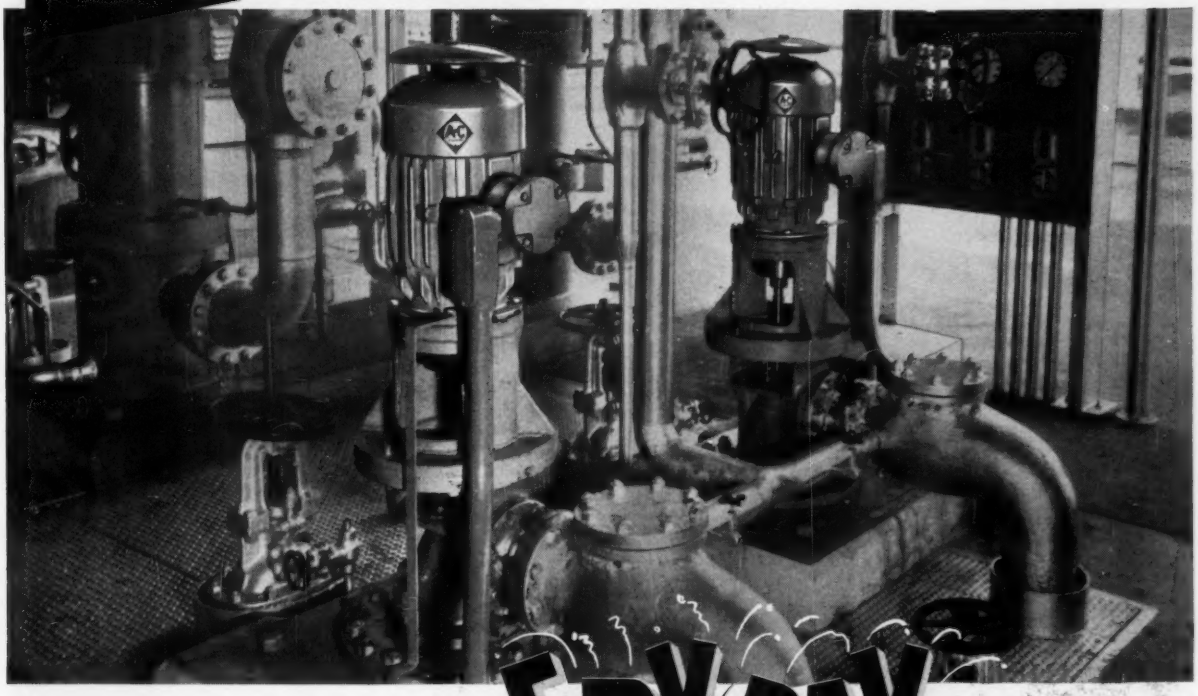
There's **MORE** Cooling Surface in these deep-ribbed **MOTORS**



No Day is FRYDAY

with these Allis-Chalmers MOTORS

● Frying of insulation is impossible under normal conditions with the extra-large cooling surface of Allis-Chalmers rib-type TEFC motors. The result—you expect and get longer motor life.

The engineered partner of A-C motors is Allis-Chalmers control.

Get Complete Information

As a new machinery component or as replacement, specify Allis-Chalmers. Discuss your particular application with your nearby A-C distributor, A-C district office, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

A-4927

PERFORMANCE VERIFIED / by acid test

Even before a Powell Valve is made, it must pass the acid test. For quality control of Powell Valves begins not with manufacture—but with the very materials which go into Powell Valves.

Constant laboratory control is one of the many ways we make certain that Powell Valves will give dependable flow control. Another is the final step of manufacture of these precision-built valves: *every Powell Valve is subjected to an actual line test.*

Because of Powell's painstaking quality control, valve repair is cut to the minimum and plant shut down through valve failure is substantially reduced. Records of performance the world over prove it.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our COMPLETE *quality line* which has PERFORMANCE VERIFIED.

The Wm. Powell Company, Cincinnati 22, Ohio . . . 110th YEAR

PERFORMANCE PV VERIFIED

FIG. 3003 WE—Steel Gate Valve For 300 Pounds W.S.P.

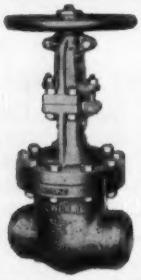


FIG. 11365—Steel Pressure Seal Horizontal Lift Check Valve For 1500 Pounds W.S.P.

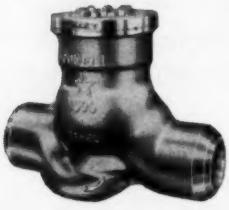
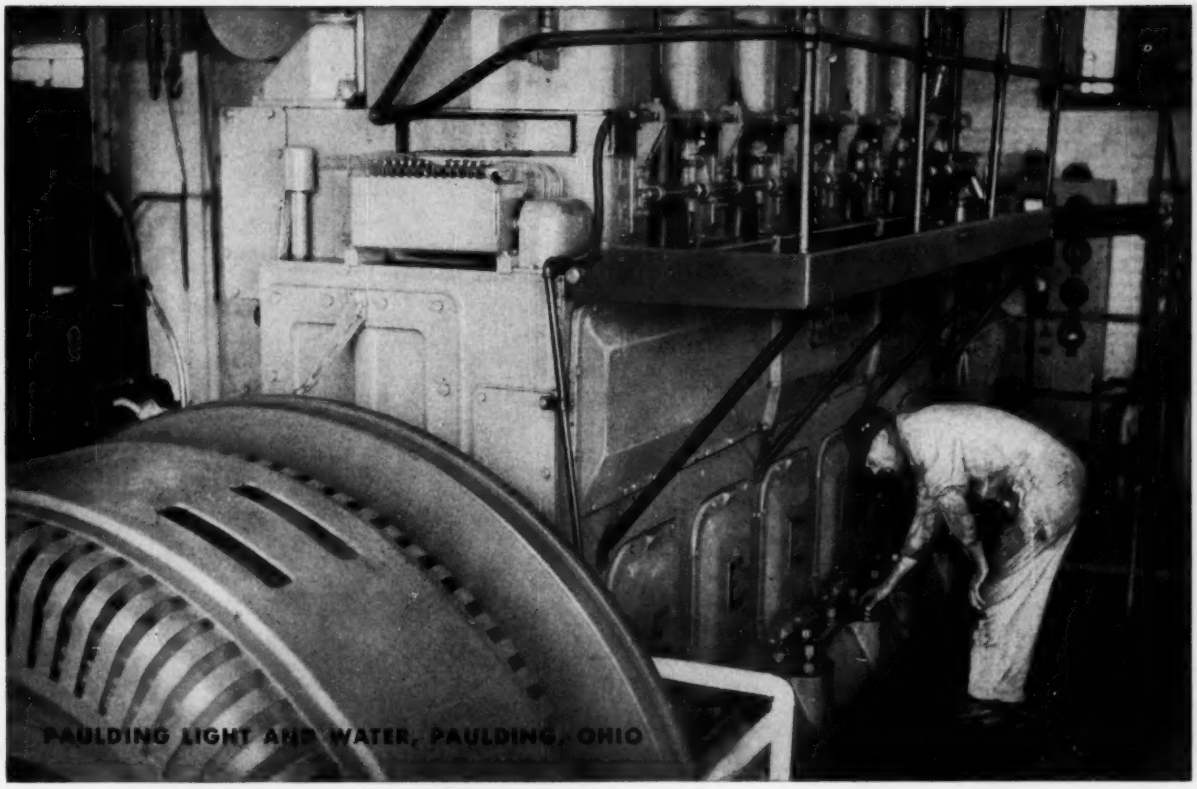


FIG. 11323—1500-Pound Motor Operated Steel Pressure Seal Gate Valve.

POWELL VALVES

BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES.



"16,587,402 H. P. hours without oil change using Cities Service C-300 Lube Oil!"

1000 KW Enterprise uses only one gallon of oil in 23,205 BHP hours, has no oil reclaimer.

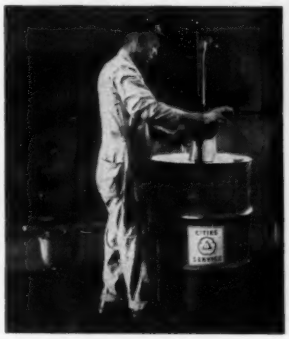
The main part of the power output of Paulding Light and Water Company is developed by its dual-fuel, 1000 KW Enterprise Unit.

Mediocre performance can't be tolerated at Paulding . . . the power load is running twice that of seven years ago!

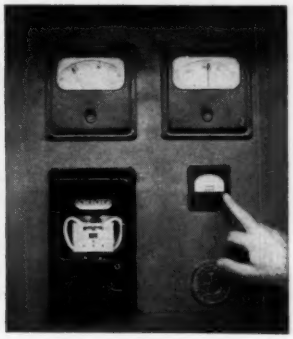
"Fortunately," says Superintendent James J. Leslie, "performance is tops—and much of the credit is due Cities Service C-300 Lube Oil. We really pile up hours with C-300 . . . and still get excellent engine life. I've never had the head off the Enterprise since it was first installed in 1953, yet compression, fire pressure, and fuel economy are still very good.

"We've actually logged up to 16,587,402 H.P. hours without an oil change. We use only 1.5 gallons of C-300 Lube Oil per day, which amounts to 23,205 brake-horsepower hours per gallon . . . and that's with no oil reclaimer! I'd recommend Cities Service to any power plant."

If you're interested in Mr. Leslie's recommendation, talk with your Cities Service Lubrication Engineer. He can tell you of other outstanding case histories. Or write: Cities Service Oil Co., Sixty Wall Tower, New York 5, N. Y.



Electric Service Goes Hand in Hand with Cities Service at Paulding Light & Water. Paulding's Enterprise dual-fuel power unit gets 23,205 BHP hrs. for every gallon of Cities Service C-300 Oil that's consumed. Oil changes are made about every 11,000 hrs.

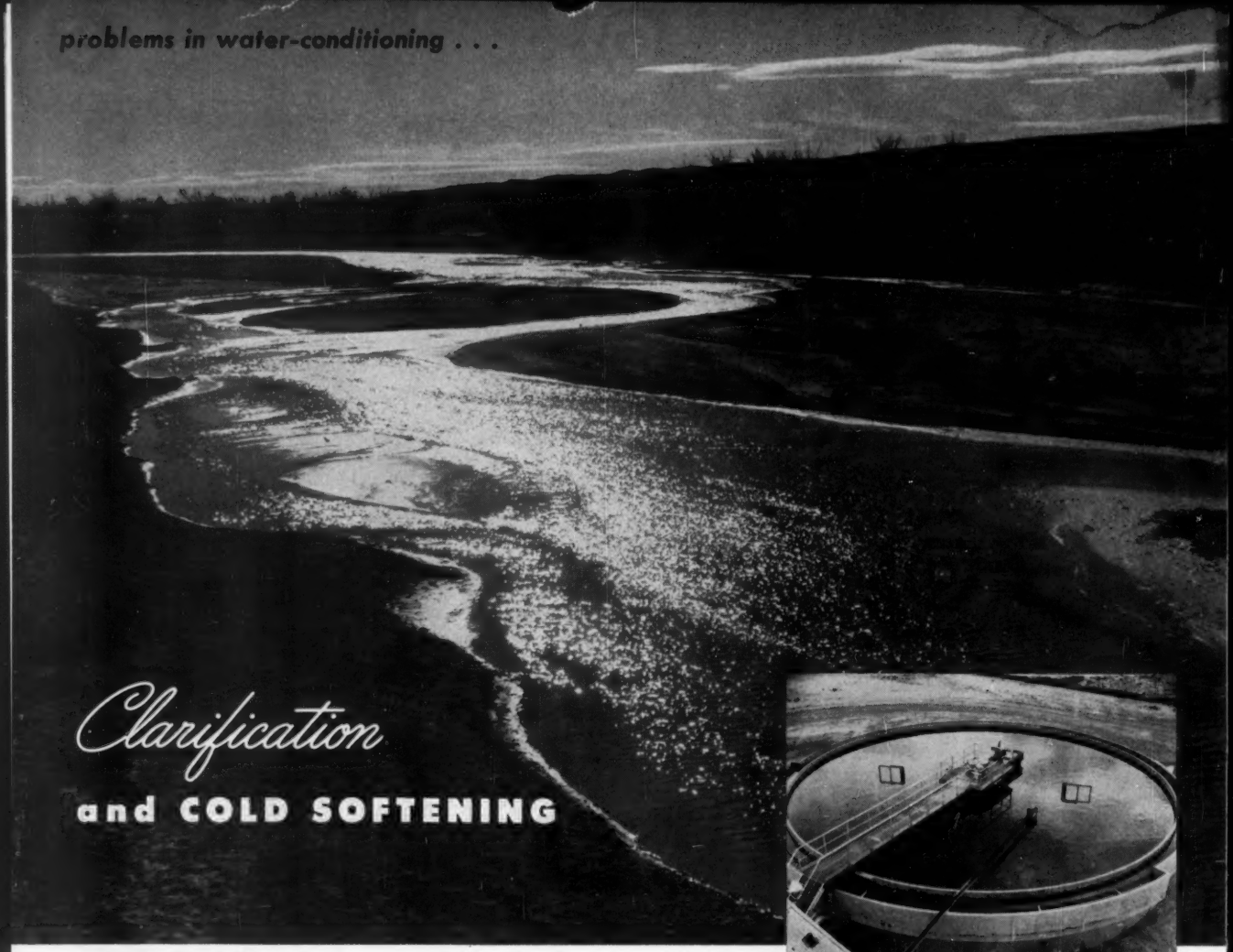


"We're Really Able to Pile Up Hours and still get good engine life using Cities Service C-300 Lube Oil," says Supt. Leslie. "I've never had the head off the Enterprise since it was installed in 1953. Compression, fire pressure, and fuel economy are excellent."

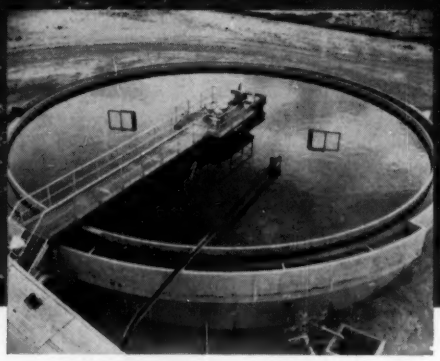
CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

problems in water-conditioning . . .



Clarification
and COLD SOFTENING



Cochrane
Solids-Contact Reactors
cut costs

Coagulation and clarification of surface waters, cold lime softening of well or surface waters, removal of alkalinity, silica, fluorides, etc., treatment of white water from paper to recover fibre and warm water are only a few of the many processes performed more efficiently—and at less cost—by a Cochrane Solids-Contact Reactor. Because of the Reactor's special "catalytic" design, the newly-formed precipitates plate out and grow rapidly—provide more complete reactions and produce clear water in shorter time, saving in size of the tanks employed. Chemical savings are impressive, and water waste is kept to a minimum. De-sludging is completely automatic.

Cochrane Corporation designs and manufactures every type of precipitation, ion exchange, deaeration and water conditioning equipment. To obtain equipment best suited to your requirements—consult Cochrane first!

For further information, write for publication 5001-A.

OIL FIELD FLOODING
AN APPLICATION OF COCHRANE REACTORS

Oil field flooding operations require water that is conditioned to prevent precipitates and suspended matter from plugging the oil-producing sandstone formations. Efficient flooding is assured by the Cochrane Solids-Contact Reactor shown above. Softening and clarification are combined in a single unit.

A FEW TYPICAL COCHRANE REACTOR INSTALLATIONS

Application	Use	Capacity gph	Size Reactor Dia.	H.
Oil Field Flooding	Softening & Clarification	350,000	1-72'0"	x19'6"
Process Water for Papermill	Softening	378,000	1-72'0"	x19'6"
Pretreatment ahead of demineralizer	Coagulation	833,400	2-82'0"	x17'0"
Process water for papermill	Coagulation & Softening	150,000	1-47'0"	x17'0"

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Cochrane
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Where does your job end?

WHEN I FIRST HEARD THE STORY it was only one of several told me to illustrate the need for better trapping in process hookups. But the more I think about it, the more it seems to drive home a point of much wider importance to all power-service engineers.

The story is simple enough. In a small process plant a batch-cooking operation took eight hours to complete. The cooker was trapped, of course, and the trap worked—that is, it discharged condensate and didn't blow steam.

But when a trap specialist made a survey of the plant he recommended replacing the trap and revising the hookup. This cut cooking time to six hours. So what?

Just this: When cooking time was eight hours, preparing the batch and cleaning up after cooking had to be done on overtime. With speedier cooking the whole job could be handled in a single shift and two hours overtime each day was eliminated. At today's wage rates, the small investment in improved trapping paid off almost immediately and now yields handsome dividends.

This proves a point about trapping, but that's only part of the picture as I see it. Here's what shapes up as the real moral in my eyes:

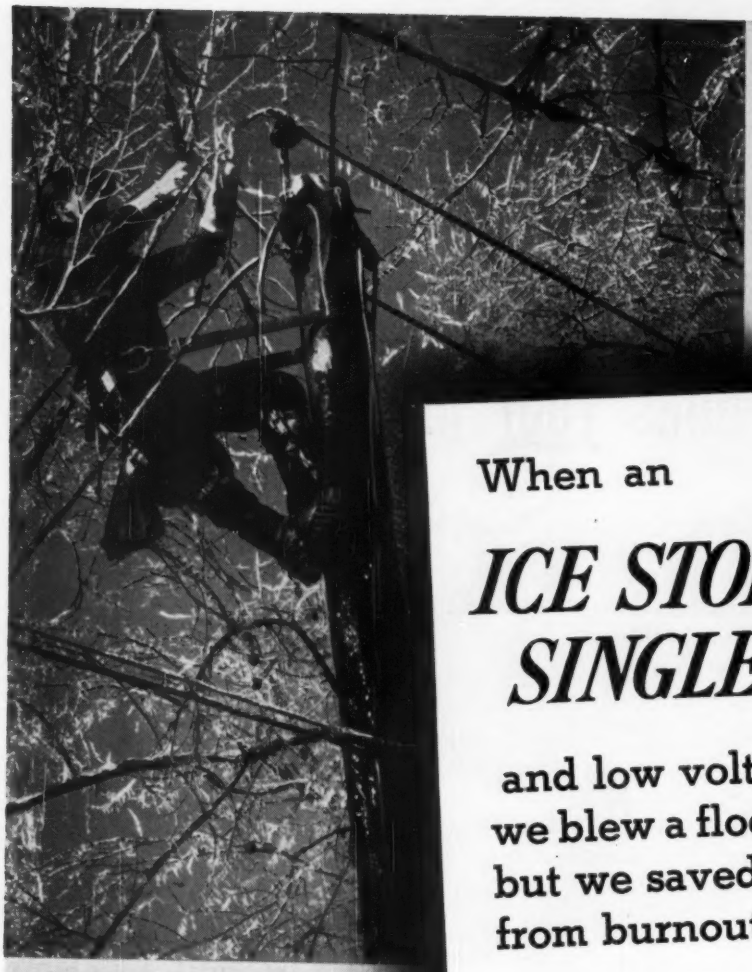
The plant engineer checked the trap regularly and assured himself that it was working in the purely mechanical sense. And he was content to look no farther.

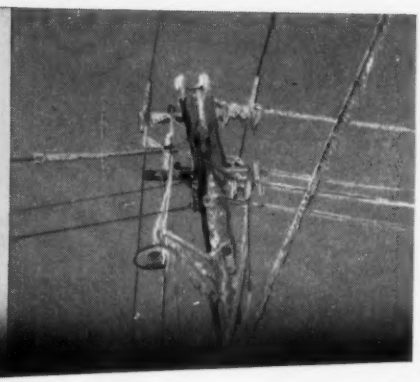
The outside specialist saw the whole picture: how trap operation affected the process, and the particular importance of the overtime angle. He saw that merely adequate performance wasn't enough, that an improvement would yield benefits far greater than the modest cost involved. And this is the kind of thinking that more power-service engineers should be doing.

In my book, the day is past when a power-service man can assume his job is done as long as he keeps equipment running smoothly. His responsibility doesn't even end when he has generated the power services with top economy and delivered them to the point of use.

One of the big untapped areas for profits lies in the application of the power services. More and more, the engineer's eyes must turn to the ways his products—steam, electricity, air, water, etc—are put to work in production. And when he looks in this direction he must see the whole picture—not merely the engineering but the economics of the entire process as well.

With such an approach the power-service engineer can play a real part in the drive to slash production costs. And, in so doing, he takes the important place in the management team to which his special skills and know-how entitle him.





When an

ICE STORM CAUSED SINGLE PHASING

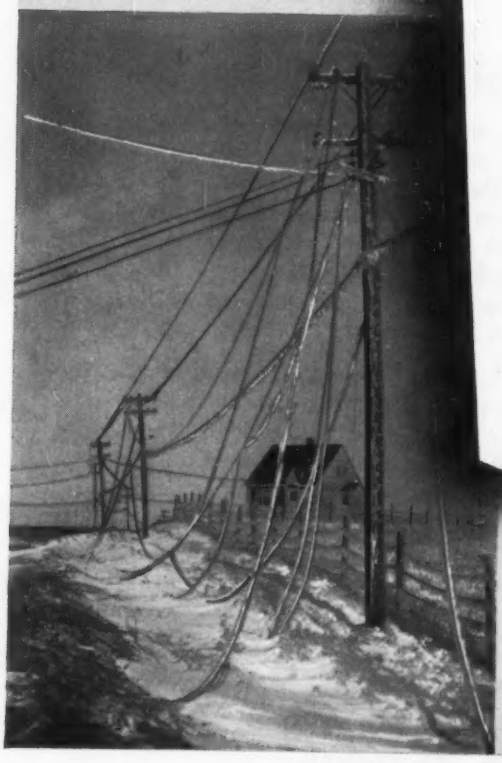
and low voltage conditions . . we blew a flock of Fusetron fuses but we saved over 40 motors from burnout

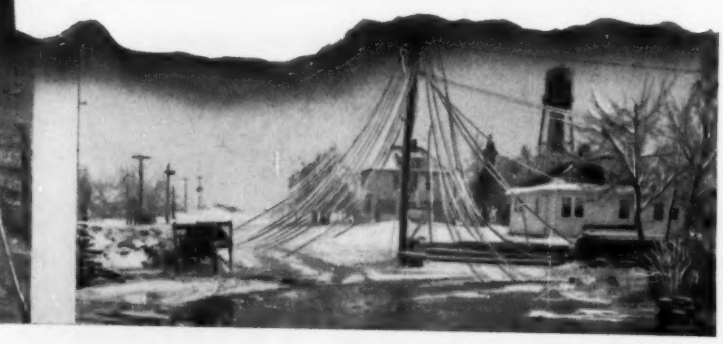
"For twenty-four hours after the bad ice storm of February 15, 1950 we were endangered by single phasing and low voltage conditions due to the damage done the power lines by the ice.

"During this period, we blew a flock of Fusetron dual-element fuses—around 240 in fact—but we figure that was a very cheap price to pay for saving over 40 motors from burning up.

"After this experience we didn't lose any time in putting all of our plant and equipment under Fusetron Fuse protection."

Michael G. Kupcho,
Master Mechanic
Ashland Shirt and Pajama Company
Ashland, Pennsylvania





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Fusetron DUAL ELEMENT Fuses

They provide 10 Point Protection

1 High interrupting capacity—protect against heaviest short-circuits. Have proven on tests to open safely on circuits set to deliver in excess of 100,000 amperes.

2 Protect against needless blows caused by harmless overloads.

3 Protect against needless blows caused by excessive heating—lesser resistance results in cooler operation.

4 Provide thermal protection — for panels and switches against damage from heating due to poor contact.

5 Protect motors against burnout from overloading.

6 Protect motors against burnout due to single phasing.

7 Give DOUBLE burnout protection to large motors — without extra cost.

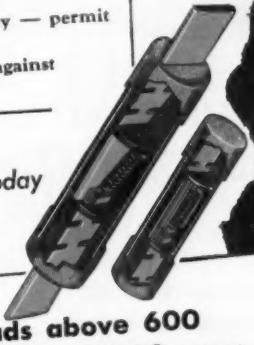
8 Make protection of small motors simple and inexpensive.

9 Protect against waste of space and money — permit use of proper size switches and panels.

10 Protect coils, transformers and solenoids against burnout.

Write for bulletin FIS.

DON'T RISK LOSSES — *Start today to install FUSETRON fuses throughout the entire electrical system!*



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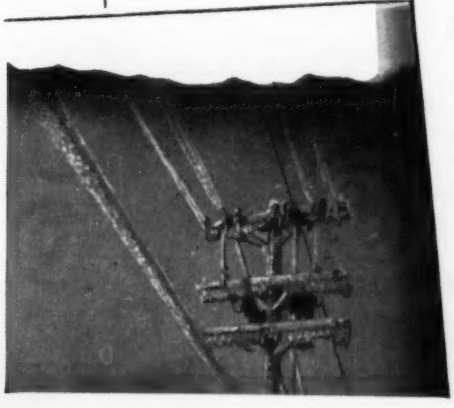

For loads above 600 and up to 5,000 amps., . . . use BUSS Hi-Cap Fuses . . .

They have unlimited interrupting capacity to handle any fault current regardless of system growth.

Overload protection as well as short-circuit protection.

Coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuits of origin.

Dependable service through the years because there are no moving parts to stick or get out of order.

Write for bulletin HCS.

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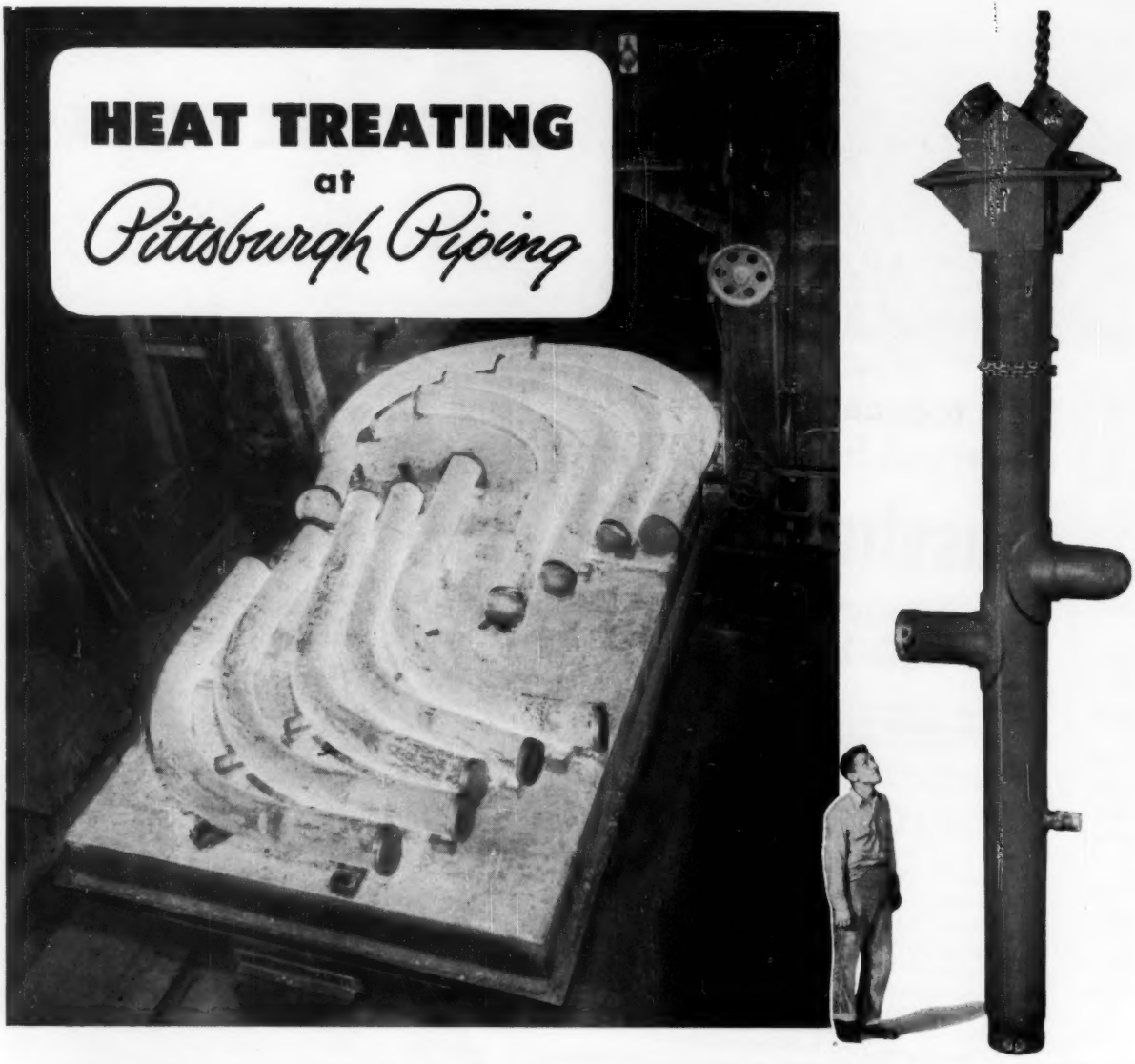

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Heat treating and stress relieving at Pittsburgh Piping are operations which produce a uniform grain structure, assure consistent mechanical properties, and remove residual stresses throughout the length of each fabricated piping assembly.

P.P.&E.'s modern gas-fired furnace, illustrated above, is a specially-developed design. Time-temperature conditions can be electronically controlled in it for proper heat treatment of each type of metal.

This heat treating procedure is assurance that piping fabricated by P.P.&E. will have the most desirable combination of ductility, toughness, impact resistance, and strength.

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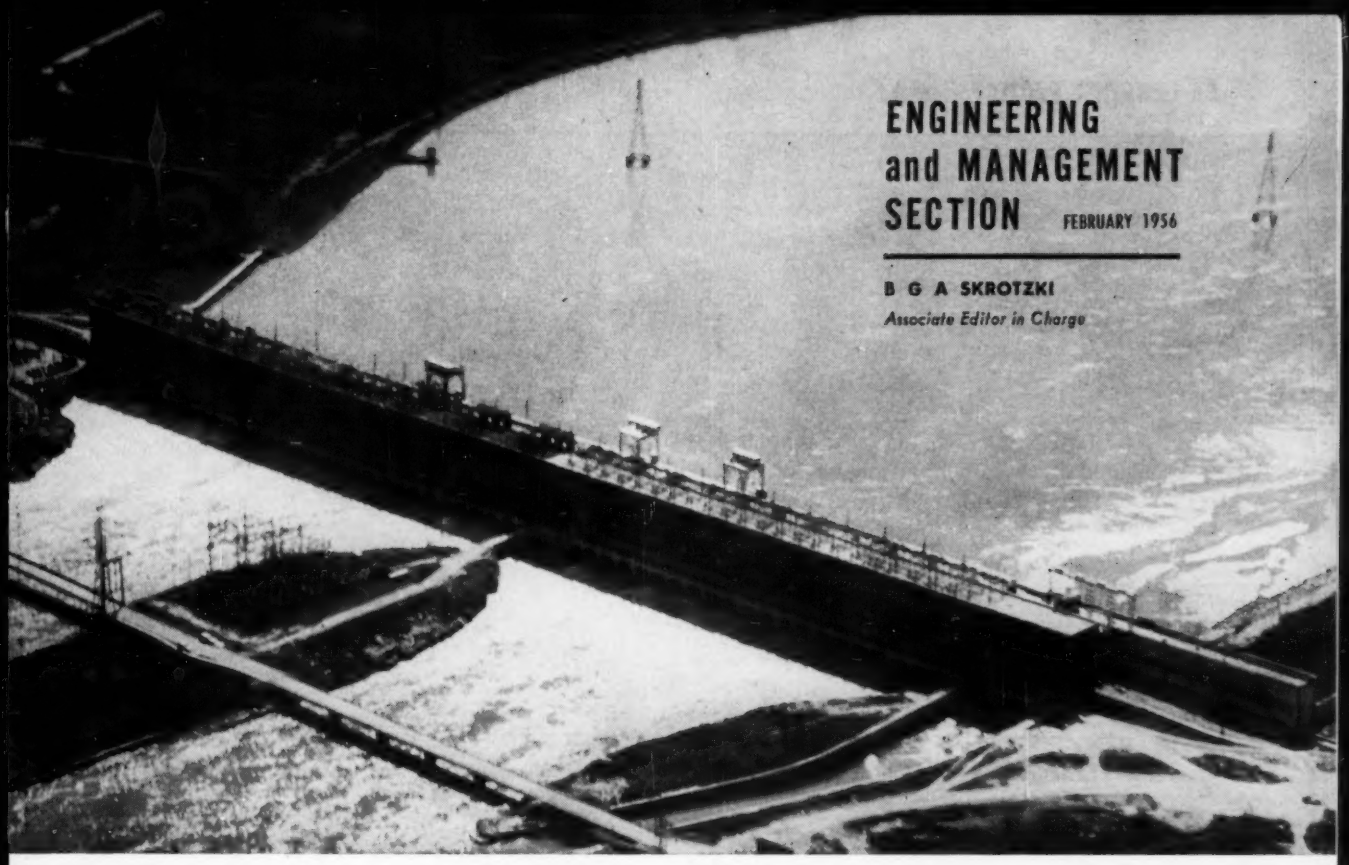


B G A SKROTZKI
Associate Editor in Charge

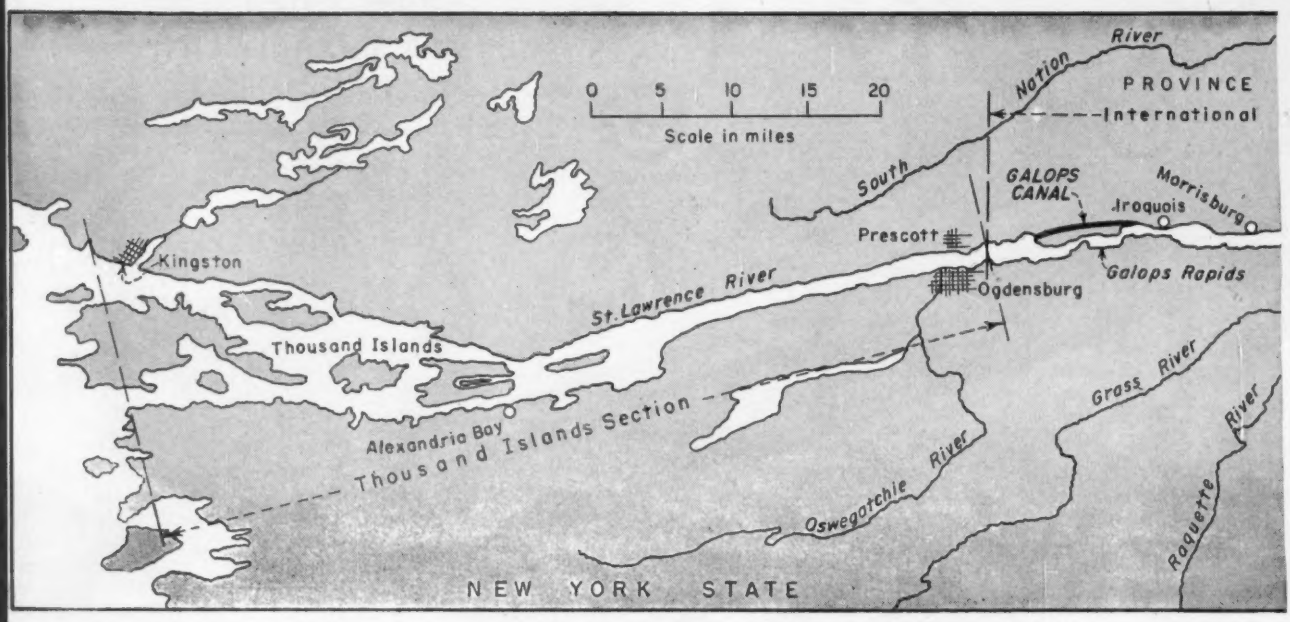
1 Beauharnois plant in the river's Soulanges Section has 1,420,000 hp installed in twenty-six 54,000-hp main and two 8000-hp service units. When completed, the plant will use the available river flow and generate over 2,000,000 hp

Work on $600,000,000 St. Lawrence power project goes into high gear

The St. Lawrence River, where 5.7-million hp and 33-billion kwhr can be generated annually, is the center of major interest for hydro power and a seaway in U.S. and Canada. Power projects in operation are described, with emphasis on the one under construction

► FOR NEARLY 60 YEARS, in Canada, in the United States and between the two countries there was a prolific source of debate on how, why, when and by whom the St. Lawrence River power and navigation should be developed. This ended in an agreement for the joint development of 2,400,000 hp in the International Section of the river by the Hydro-Electric Power Commission of Ontario and the Power Authority of the State of New York. Before discussing this project, which is only one of three major power developments on the river, we will study the others. We'll see what the power potential of the St. Lawrence is and who is interested in these projects.

Power developments. From Lake Ontario to Montreal the St. Lawrence flows 182 miles and falls about 225 ft, with a maximum discharge of 300,000 cfs, a minimum of 140,000, and an average flow of 236,000 cfs. This part of the river can be divided into five sections: (1) The Thousand Islands. In this section, which extends from Lake Ontario to below Prescott, Ont. and Ogdensburg, N.Y., there is practically no fall. (2) Extending from Ogdensburg



2 From Lake Ontario to Montreal, the St. Lawrence is 182 miles long, falls 225 ft. Discharge is: maximum 300,000 cfs, minimum 140,000, average 236,000. In the three sections of International, Soulanges and Lachine Rapids, a potential of

to St. Regis, N.Y. and Cornwall, Ont., the International Section includes the Galops and Long Sault Rapids, and falls about 92 ft. (3) Lake St. Francis lies between the provinces of Quebec and Ontario and has practically no fall. (4) With a drop of 83 ft, Soulanges Section extends from Lake St. Francis to Lake St. Louis. (5) Bordering the City of Montreal, the Lachine Section extends from the head of Lake St. Louis to below Lachine Rapids and has a fall of 50 ft, Fig. 2.

In the power sections of the river 5,700,000 hp can be developed. 2,400,000 hp in International, 2,200,000 in Soulanges, and 1,100,000 in Lachine Section. Of the power generated in International Section, one half or 1,200,000 hp, goes to New York State. The other 1,200,000 hp belongs to Province of Ontario. The other two power sites with a potential of 3,300,000 hp, nearly three times that in either Ontario or New York State, are in the Province of Quebec. Of the potential power of the river about 1,800,000 hp have been developed, mostly in the Province of Quebec.

Power around Montreal. Montreal City is on the Island of Montreal with the Ottawa River discharging on its north side and the St. Lawrence with Lake St. Louis and Lachine Rapids on its south, Fig. 2. The Ottawa River flows into Lake of the Two Mountains, which has four natural outlets leading into the St. Lawrence. Two of these, Vaudreuil and St. Anne, have a drop of 5 to 8 ft. Back River forms a third outlet about 25 miles long, between the Island of Montreal and Ile Jesus. Mille Iles River, the fourth and smallest outlet, runs north of Ile Jesus.

Power is not developed from Lachine Rapids except in industrial plants. But, on the north side of the city on Back River, there is a plant designed for 120,000 hp in ten units. With six propeller turbines to run under a head of 18 to 26 ft, it went into operation in 1929. These turbines were designed to develop 12,000 hp under 26-ft head and 7150 hp at 18-ft head.

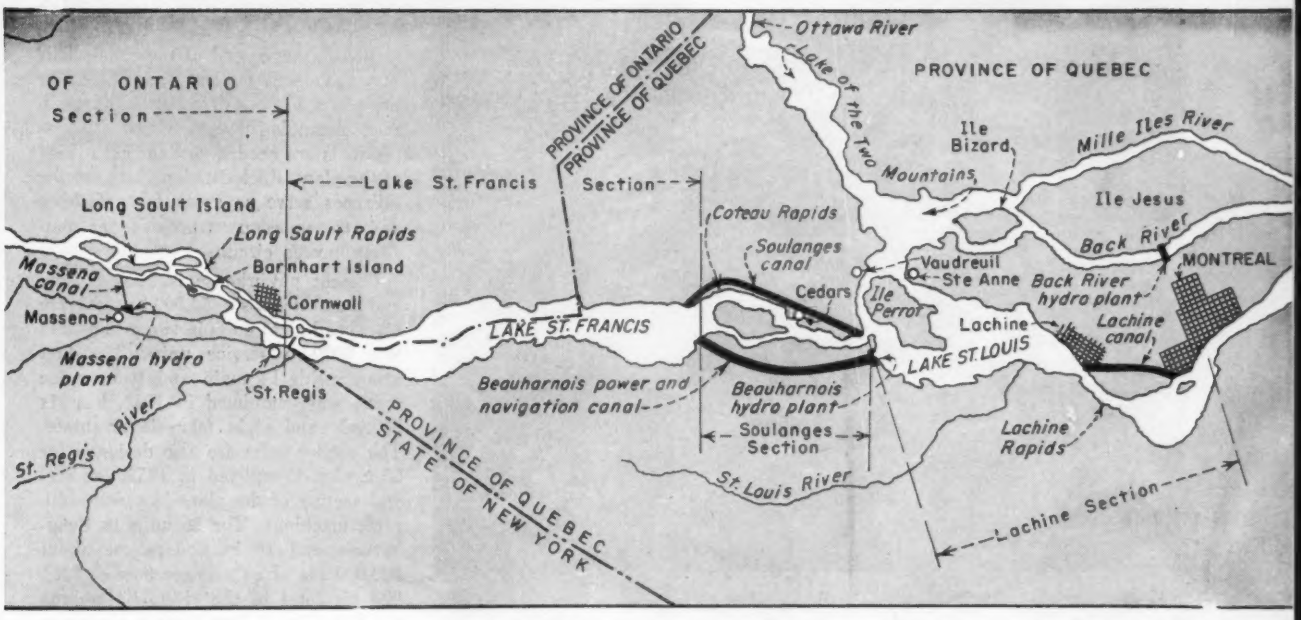
Normally this plant does not operate with water from the St. Lawrence. In winter, however, ice may restrict the flow in Lachine Rapids to where Lake St. Louis level is raised above that in Lake of the Two Mountains. During such periods discharge of the Ottawa, plus part of that from the St. Lawrence, goes down the Back and Mille Iles Rivers. As a result, flow increases considerably in Back River when it can be used during low flow from the Ottawa.

Effects of developing Lachine Rapids on water flow around Montreal depends on how much Lake St. Louis level is raised. One proposal would raise the level of this lake to that of Lake of the Two Mountains, north of Montreal City.

Cedars plant. In Soulanges Section between Lakes St. Francis and St. Louis, St. Lawrence River falls 83 ft. It has two large plants of the Quebec Hydro-Electric Commission with a total installed capacity of 1,625,000 hp, Fig. 3. In this section, Cedars plant has 210,000 hp installed. When built it was one of the world's outstanding plants. Construction, started in 1915, was completed in 1925 with eighteen 11,000-hp main units operating under 32-ft head at 55.6 rpm, and six 1500-hp exciters. Turbines are francis type with runners 17 ft, 7½ in. diameter, weighing 200,000 lb. They were the largest francis runners built up to the time of their installation.

The main generators, rated 10,000 kva, have frames 32 ft outside diameter, installed in a plant 1200 ft long. This plant is below Cedars Rapids, Fig. 3. Water for it is diverted from the river above the rapids by an embankment paralleling the river's flow. This old plant has an excellent record. During World War I some of its units operated 30 months continuously without shutdown.

Other old plants. Two other comparatively small plants in this section of the river are shown in Fig. 3. One, that of the Canadian Light & Power Corp, took water from the old Beauharnois canal and discharged into the river to generate 26,400 hp under a



over 5,700,000 hp is available. Of this amount, 1,800,000 hp are now developed. Beauharnois project now operating in the Soulanges Section is planned to use this section's full potential for power development and a deep-seaway canal

40-ft head. The other, Provincial Light & Power Co plant, diverted water from Soulanges canal to generate 16,000 hp under 52-ft head in a plant below Cedars. Also, the Montreal Cotton Co used water under a low head for power generation in its mills at Valleyfield. All these plants have been shut down, the water rights going to the Quebec Hydroelectric Commission for its Beauharnois development.

Beauharnois development is the first project planned to use the full potential of a site on the St. Lawrence River. Initial work was planned for ultimate maximum power production as part of a deep waterway, as proposed by the International Joint Board of Engineers. All former power developments on the St. Lawrence have been by side diversion of a part of the flow into low-head plants. When completed, Beauharnois development will use the available flow of the river and the full head in Coteau and Cedars Rapids between Lakes St. Francis and St. Louis.

A canal 15 miles long is a main feature of the project. It starts in Lake St. Francis and runs across relatively flat country to a forebay above Lake St. Louis near the town of Beauharnois, 25 miles from Montreal. The powerhouse across the outer end of the forebay is about 1000 ft inland from the lake with a tailrace excavated 500 ft out into it to reach deep water for plant discharge.

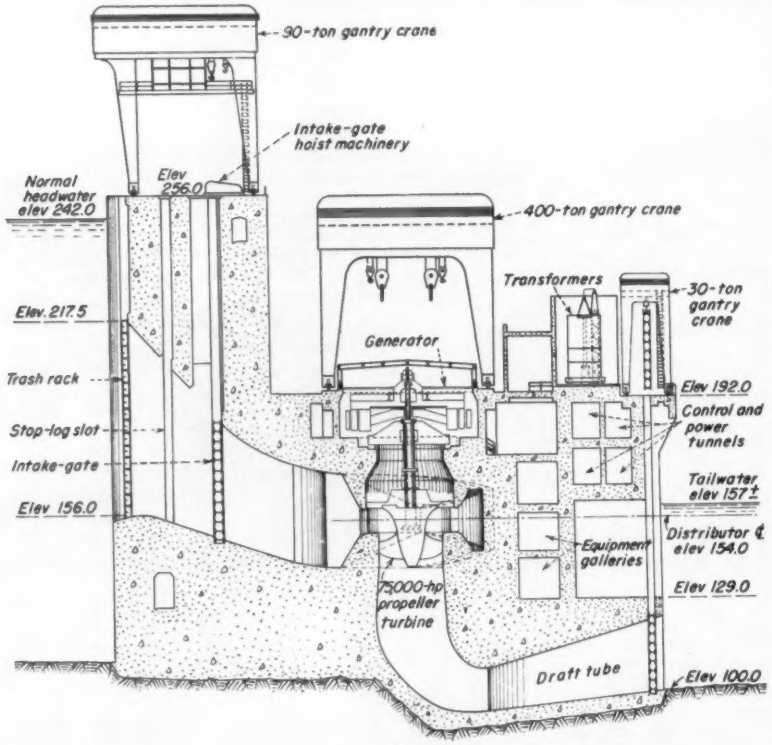
3 The Beauharnois power and navigation canal is 15 miles long, 3300 ft wide and 27 ft deep. It will take full flow of the St. Lawrence for power generation

Nature was unusually kind in this project. Marine clay underlies the canal for its full length, except for solid rock at the lower end where the powerhouse is being built. This route also lies below the level of Lake St. Francis so the canal is formed mainly by two earth dykes, 10 to 24 ft high.

The canal between the dykes is being hydraulically dredged. Eventually, it will be 3000 ft wide at the bottom and 3300 ft wide on the surface between dykes, with a navigation channel, which is 27 feet deep and 800 ft wide, along its north dyke. To complete the canal, a total excavation of 210,000,000 cu yd is required.

The canal's great width is needed to carry practically the total flow of the St. Lawrence River at 1.5 miles per hr as required for navigation. The Canadian government will build navigation locks from Lake St. Louis into the lower end of the canal to make it part of a

4 Power and seaway site in the St. Lawrence River, International Section, where 2,400,000 hp are being developed: 1,200,000 hp in Canada, same amount in U.S.



5 Cross section through one of thirty-two 75,000-hp 87-ft-head units that are to be installed in a powerhouse 3200 ft long at the foot of Long Sault Rapids

deep seaway now under construction.

Control works. These are built in the St. Lawrence to divert water into the canal. They consist of dams across the four river channels at the head of Coteau Rapids. Forming the center section of each dam are piers with gates, flanked by rock- and earth-filled dykes. Heights of 35 gates, 50 ft wide, vary with their sill's elevation.

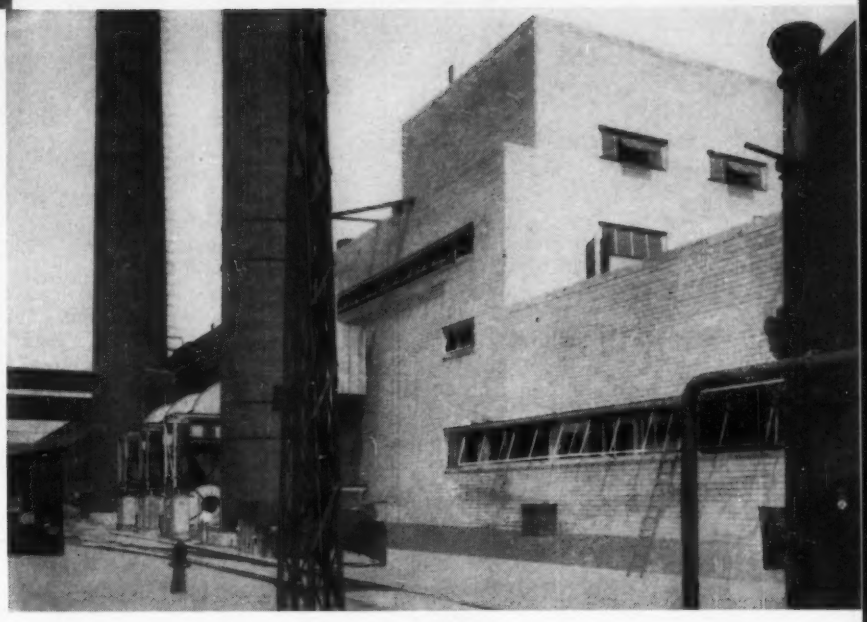
The powerhouse is built on a solid-rock ledge, which is about 1000 ft wide at the discharge end of the canal. This serves as an excellent foundation for the plant, but requires cutting the tailrace channels in rock. Three of these channels are needed, one for each third of the plant. Rock divisions between the tailraces serve as areas for switching and transmission structures for outgoing power circuits.

Present powerhouse is 2200 ft long and has twenty-six 54,000-hp 100-rpm 80-ft-head main units in two groups and two 8000-hp service units. The first group, with 14 main and two service units, was completed in 1947, has six 25-cycle and eight 60-cycle machines. The service units are also designed for 60 cycles. Completed in 1953, the second section of the plant has twelve 60-cycle machines. The 26 units in Beauharnois and 18 in Cedars use about 200,000 cfs of an average flow of 236,000 cfs total in the river. Before the third section of Beauharnois plant can be completed, Cedars will have to be shut down and its flow used in the new plant. When the deep seaway is completed, Soulanges canal can be abandoned and most of the river's flow taken into Beauharnois power and navigation canal. Upon completion, the plant will have 40 or 42 main units with a total capacity of about 2,200,000 hp, making it one of the world's largest single hydroelectric plants, 3300 ft long.

All turbines are vertical-shaft francis type. Because of the comparatively low head, 80 ft, and high power of these turbines, their parts are massive. Each unit's speed ring is 27 ft in diameter, 12 ft high, weight 168,000 lb. It is made in six segments, bolted together. Each cast-steel runner is built in four segments having vanes cast integral with the crown and band. A runner with its crown and band weighs 234,000 lb, has a maximum finished diameter of 19 ft and is 11 ft, 2 in. high. They are among the largest francis runners in the world.

International Section. One of the world's great hydroelectric plants is being constructed here at a cost of about $600,000,000. This is probably the highest investment ever made in a single power development. The powerhouse, which will be over 3200 ft long, will have installed 2,400,000 hp and will generate annually 13-billion kwhr, divided equally between Hydro-Electric Power Commission of Ontario and Power Authority of the State of New York. Cost of the project will also be divided evenly between the two agencies except for machinery and equipment for each half of the powerhouse, which

(*Continued on page* 196)



BEFORE AND AFTER. Old Juniata power plant, dating back to 1905, makes way for up-to-date powerhouse. Since old, new buildings are on same site, construction and demolition had to be carried out together. Old boilers supplied steam to railroad shops during changeover

At Pennsy RR's Juniata power plant the byword was . . .

Modernize—but don't interrupt production

► PENNSY RR's Juniata shops—part of their vast Altoona Works—are more than a hundred years old. The original boiler plant dates back to 1905. But thanks to a carefully conceived modernizing program, the plant is right up-to-the-minute when it comes to smart power services.

Why they modernized

• **Low steam pressure** in shop buildings was costing Pennsy production delays, dollars each year. And there wasn't enough steam available to properly heat the vast plant area.

• **Before the revamping,** transmission-line failures during several heavy storms left shops without power. Man-hours lost by these unavoidable shutdowns were costly, threw repair schedules out of kilter.

• **Heavy flyash emission** from the stack was a nuisance, both to the Altoona Works and the community.

• **Obsolete firing methods** made high-grade coal a must. And engineers had no way of controlling combustion air flow in proportion to steam demand of railroad shops.

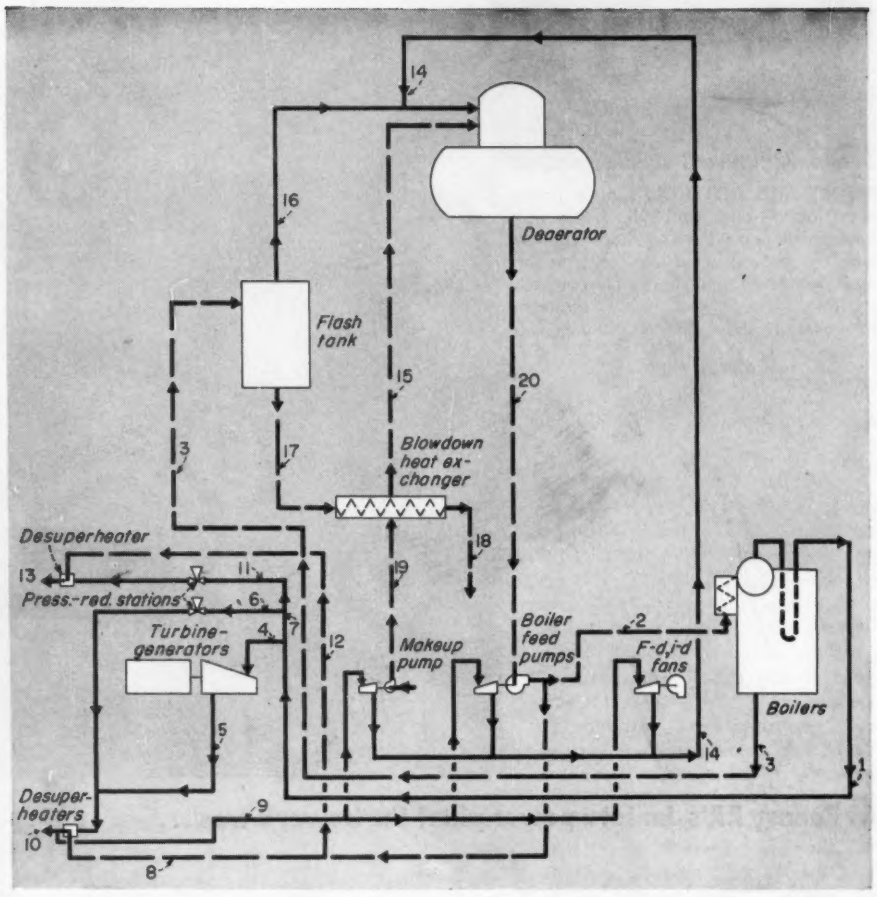
Timing . . . the all-important factor

• **Modernized plant sets on same site as old,** so construction crews had to tear down and build at the same time. The byword was: Don't interrupt steam supply to the shop area.

Power MODERNIZATION PROGRAM

A 1955 AWARD WINNER

POWER acknowledges the cooperation of the following in furnishing information for this article: V P Schmidt, Works Engineer, Altoona Works, Pennsylvania Railroad, also of R F Lux and H Walters, Engineers, Gibbs & Hill, Inc.



HOOK-UP DIAGRAM NUMBERS refer to the numbers in table on the facing page

Juniata power plant is favored with an ideal

In carrying out their mission, Pennsy and Gibbs & Hill, Inc —designers and constructors for the project—spotted footings for the new building just outside existing foundation lines. They had to undercut the old foundation, supporting the entire boiler operating floor, to provide for excavation and forming of the new coal-hopper pit, column footings.

Old boilers supplied plant needs for process steam until first of the new units swung into operation. High-pressure steam fed the locomotive repair shops through a reducing valve while the noncondensing turbines were being erected.

Process steam to spare

• **Pulling out eight old boilers,** and their antiquated auxiliaries, Pennsy engineers installed three 60,000-lb-per-hr units operating at 610 psig, 635 F. Spreader-stokers allow use of relatively low-grade coals.

Three boilers feed two new 1500-kw backpressure turbine-generators. For added flexibility, pressure-reducing and desuperheating stations parallel the turbines. But in normal flow, steam-pressure and temperature drop to 150 psig, 410 F is through the turbines. Result: Electrical power is a by-product of process-steam demand.

• **Boiler plant operates on 100% makeup,** so deaerators carry a heavy load. To supply them with low-cost steam, main plant auxiliaries are powered by 150-psig turbine drives. Turbines exhaust to the deaerators at 5 psig.

Figuring, see heat-balance table, top, p 79, showed that at certain loads, exhaust from steam-driven auxiliaries would exceed deaeration needs, force the Juniata power plant to spill steam to the atmosphere. But engineers got around this problem by hooking dual drives (motor and turbine) to one of three boiler feed pumps. Drivers operate together at motor speed. Steam-inlet valve on turbine drive is controlled by exhaust-steam pressure. Pressure drop opens valve, allows steam to flow through turbine. Advantage of this setup: Deaerator steam demand is satisfied, motor current demand dips. Small steam bypass cools the pump turbine when steam-inlet valve to the turbine is closed.

Dependable low-cost electrical power

• **Juniata bought all electrical power** before modernizing. And during several severe storms, transmission-line failures caused unavoidable power loss. Shutdowns were costly.

Now with two 1500-kw noncondensing turbine-generators in parallel with utility company supply, electrical service has added flexibility. Here's how the parallel arrangement works: Normally, turbine-generators produce only byproduct power. To hold process-steam conditions, leaving turbines,

Heat balance data for typical summer, winter operation

Line No.	Description	Typical Winter Load				Typical Summer Load			
		Lb/hr	Psia	Temp, F	Btu/lb	Lb/hr	Psia	Temp, F	Btu/lb
1	Steam from boilers	176,612	615	630	1308.6	132,227	615	620	1301.5
2	Boiler feed	198,612	–	228	196.2	154,227	–	228	196.2
3	Boiler blowdown	22,000	656	496	48.3	22,000	665	497	484.8
4	Steam to turbines	135,000	615	630	1308.6	132,227	615	620	1301.5
5	Turbine exhaust	135,000	165	410	1222.6	132,227	165	410	1222.6
6	Steam to 150-psig PRV	41,612	615	630	1308.6	0	–	–	–
7	Steam to reducing stations	41,612	615	630	1308.6	0	–	–	–
8	Desuperheating water (150-psig steam)	3,487	–	228	196.2	0	–	–	–
9	Steam to auxiliaries	25,099	165	410	1222.6	12,227	165	410	1222.6
10	150-psig steam to shops	155,000	165	410	1222.6	120,000	165	410	1222.6
11	Steam to 300-psig PRV	0	–	–	–	0	–	–	–
12	Desuperheating water (300-psig steam)	0	–	–	–	0	–	–	–
13	300-psig steam to shops	0	–	–	–	0	–	–	–
14	Exhaust steam to deaerator	25,099	20	228	1156.3	12,227	20	228	1156.3
15	Deaerator makeup water	170,428	–	50	17.78	135,386	–	95	62.6
16	Flash steam to deaerator	6,572	20	228	1156.3	6,614	20	228	1156.3
17	Flash-tank drain	15,428	–	228	196.2	15,386	–	228	196.2
18	Drains from exchanger	15,428	–	54	22.07	15,386	–	100	67.97
19	Makeup water to exchanger	170,428	–	34	2.02	135,386	–	80	48.02
20	Water leaving deaerator	202,099	–	228	196.2	154,227	–	228	196.2
	Fuel	3 Boilers, coal fired				3 Boilers, coal fired			
	Turbines – kw. output	3,000				2,800			

balance between process steam and electrical power

at 150 psig, 410 F, superheater outlet temperature varies with the steam load demand in the shops.

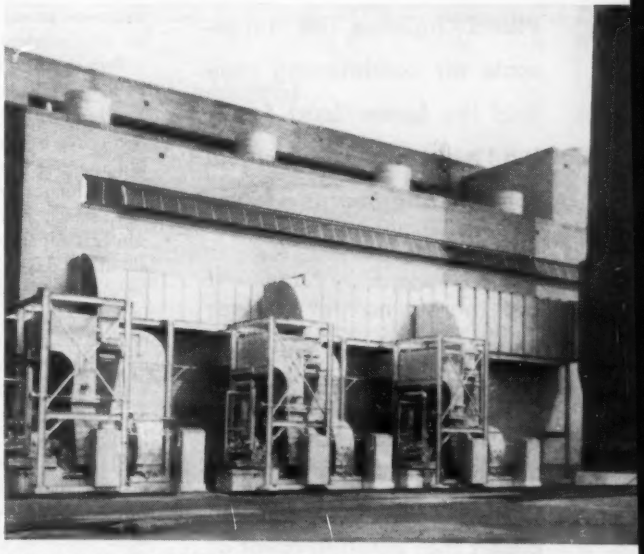
• **If utility supply fails,** generators can operate at full capacity with excess steam spilling to the atmosphere through relief valves. A frequency-sensitive relay energizes a tripping circuit to cut off nonessential loads step by step so electrical demand doesn't exceed generator capability. The setup avoids tripping out important motors.

• **If noncondensing units fail,** utility standby service takes over through feeder that energizes the boiler load center. Load center normally gets its power from the new generators.

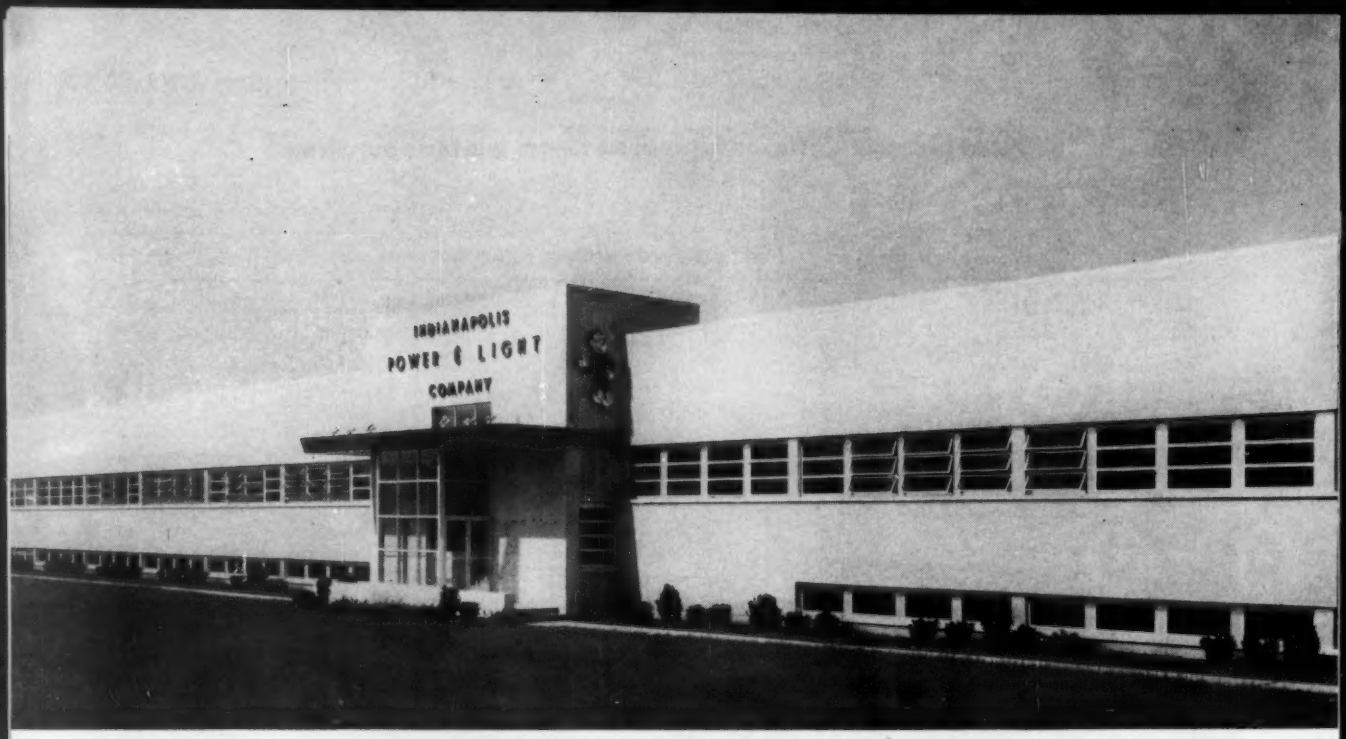
New generators are 2400 v, 3 phase, 60 cycle, with exciters directly connected to generators. Generator cables originate at switchgear in a building west of the turbine room. Cable trays run in space above the building crane rail. Outdoors, cable dips into underground duct that carries it into the turbine room of the Juniata power plant.

Sweeping modernization . . . sweeping results

• Estimated yearly savings—a cool half million • Production delays, due to low steam pressure eliminated • Boilers now burn low-cost coal • Air-pollution headaches licked • Electrical services more flexible, reliable • Manpower needs trimmed down due to more efficient coal, ash handling



OUTDOOR FANS, both f-d and i-d, are on single shaft with a single turbine drive. Control is by speed, damper



SERVICE-CENTER BUILDING adopted all-electrical heating for office and industrial areas. The 1,143,800 cu ft of space is heated with 1122 kw. Cement-block walls, 8 in. thick, are brick-veneered in office sections. Roof has 1-in. insulation

Electrical heating is best . . . sometimes

Plants figuring on large-scale air conditioning may find the better load factor gained by all-electrical space heating earns a lower power rate

But there's no pat answer on whether electrical heating is best for you without a careful study beforehand

Here are highlights on two plants that voted in favor of no smokestacks

► THERE ARE few plants today that can design for electrical space heating and water heating throughout, and have the finished job stack up favorably against other forms of plant heating. Geographical location of proposed plant, air-conditioning scheme and utility-rate structure strongly influence any plans for all-electrical industrial heating.

Two plants that have adopted the stackless all-electrical heating system are Duffy Silk Co at Murphy, N. C., and Arlington Service Center belonging to Indianapolis Power & Light. Both plants have climates far from ideal. At Murphy, smack in heart of the mountains, winter temperatures drop below zero F about 15 days each year. Early plans here favored steam heat with oil-fired boilers. Switch to all-electrical heat came once air-conditioning plans firmed up. Improved load factor prompted favorable power rates, traceable to air-conditioning summer load and electrical heating in winter.

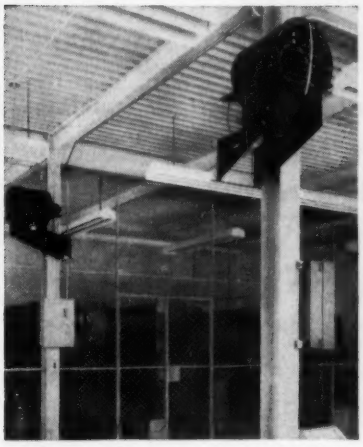
Standard electrical heating equipment heats air in ducts. Controls are a simple arrangement of standard magnetic contactors, wired to connect individual duct heater circuits in series or parallel. Pneumatic thermostats operate the pneumatic-electric switches that control the circuit contactors.

Service Center of Indianapolis P & L, photos, was originally slated for an oil-fired hot-water heating system. Before these plans jelled, thought was given to heat pumps using a well-water supply for heat transfer. Test drilling ruled this out because of scanty water supply. All-electrical was final choice.

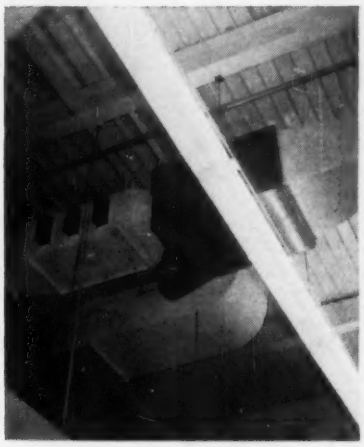
Building uses standard industrial construction: 8-in. cement-block walls with office sections brick-veneered. Floors are 8-in. concrete slab while roof is a metal deck with 1-in. insulation. Total space heating amounts to 1122 kw, or 3,830,000 Btu. Water-heating accounts for 96 kw or 328,000 Btu. Space being heated tallies up to 76,935 sq ft, or 1,143,800 cu ft. No air conditioning has been installed yet although it will be a simple job because of the existing ducts for space heating.

Heating equipment includes electric baseboards, off-the-floor space units, air-duct heaters, convectors, water heaters and strip units, photos, facing page. Plant load is measured through primary watt-hour and demand metering. A 1000-kva transformer carries heating and power load for entire center.

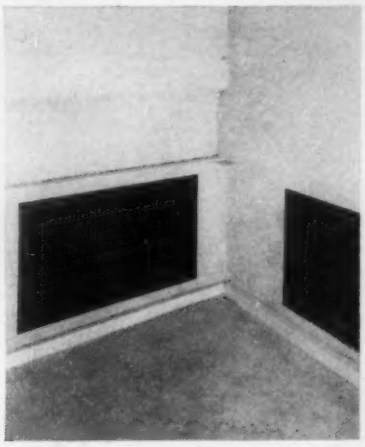
These 5 electric units met the space- and water-heating needs in Indianapolis plant



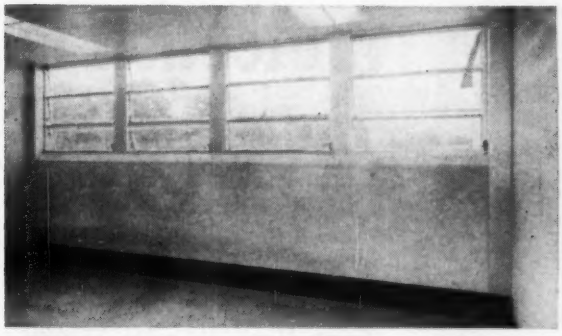
UNIT HEATERS rated 5 to 50 kw serve the stock areas and maintenance sections



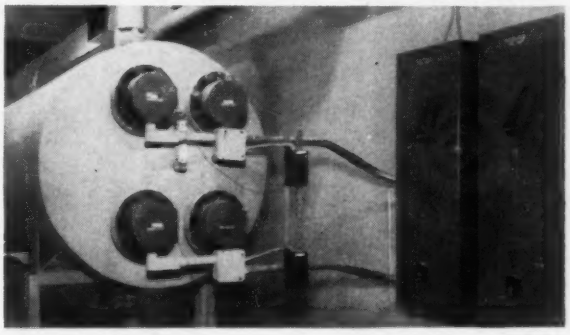
AIR-DUCT HEATER in building basement warms vent air, carries a 15-kw rating



CONVECTOR design for recessed electrical heater handles stairwells: rated 3 kw



BASEBOARD UNITS stretch beneath all office windows. Panels are 1, 2, 5 ft long and are rated 100, 300 and 800 watts



WATER HEATERS immersed in basement insulated storage tank draw 96 kw when all four heater sections are in operation

Transistors make bid for industrial control

► THE TINY TRANSISTOR—a lab curiosity not many years back—is proving a versatile, precise and often economical valve for controlling electron flow in circuits.

But while transistor development is not yet at the stage where industrial applications are widespread, control engineers are finding needs where transistor's properties can best be utilized. The following two experimental designs by Westinghouse indicate a few possibilities for future.

In metal working, a new hot-metal detector uses a phototransistor as an infrared sensing device, plus other transistors in the amplifying circuit. Device can be applied where a metal object at 700 F or above must be detected and a signal transmitted to indicate its presence.

Typical application would be in rolling-steel tubing. With a specified volume of metal to start and a constant outside diameter, tube-wall thickness can be determined by tube length. If pipe is rolled with too thin a wall, tube will be longer than specified. Conversely, if wall is too thick, the tube will be shorter. So wall thickness can be pinned down as a function of tube length. By spotting several hot-metal detectors at specified distances apart, pipe length can actually be measured to determine wall thickness.

Constant-current control for motors, still experimental, uses static semiconducting elements, mainly transistors and silicon-diode rectifiers. This control might well be used to maintain constant hp on a steel-mill reel drive. In a lab model developed by Westinghouse, a ¾-hp dc shunt motor serves as a driving motor. Voltage drop across a shunt in dc armature circuit provides a signal proportional to armature current. This signal is fed to the regulator, which automatically adjusts dc motor's shunt field to maintain constant armature current, thus constant hp.

In addition to benefits of a static control, regulator is small and has rapid response. Experimental model, while using a ¾-hp motor, has enough capacity for a 3-hp motor. While still in its infancy, this development serves as an indicator of promising future for transistors in control. Same basic regulator could control speed as well.

SOCONY-MOBIL BUILDING, New York, now nearing completion, is but one of a growing number of commercial buildings being serviced with 265/460 v power

Large commercial buildings are fast adopting 460 v for electrical distribution. But higher voltage emphasizes need for careful study of short-circuit needs. Here's a timely run-down, outlining the problem and some ways to lick it

Protection is

► THE LARGE, MODERN COMMERCIAL BUILDING has a load characteristic much like that of an industrial plant. There is a heavy motor load—air-conditioning compressors, fans, elevators, pumps—which is fast becoming a likely candidate for voltages higher than 120/208 (POWER, March 1954, p 74). Thinking in terms of a 460-v system, the heavy general-area fluorescent lighting is operated off line-to-neutral voltage with higher-voltage ballasts (October 1953, pp 122-123).

Building service feeding any sizable commercial building is generally tapped off the paralleled low-voltage side of several transformers, which in turn are fed from low-impedance high-voltage lines. Typical setup might have six 2000-kva transformers with 7% impedance. Here a bolted short circuit at the service entrance to building might well pull 175,000-amp rms asymmetrical. The problem crops up at this point since interrupting capacity (IC) of breakers, designed for use in circuits up to 600 v, is often within 100,000 amp.

These high fault currents are nothing new since calculated values for the present 120/208-v systems approach 200,000 amp. But at this lower voltage the calculated fault current decreases rapidly as distance from power source increases. But at 265/460 v, inherent circuit impedance does not reduce available short-circuited current as rapidly. So distribution designer must give that

Current-limiting fuses to back up circuit breakers?

This business is not as simple as it sounds. When a current-limiting high-interrupting-capacity fuse is considered for series hookup with a circuit breaker, it's because available short-circuit current exceeds breaker's interrupting capacity. And in such a setup fuse must limit fault current to a value that will not damage breaker.

Coordination of whole electrical distribution system must be considered—right from the incoming high side of transformers to the final point of utilization. Before jumping to the fuse-breaker combination plan, consider your service continuity needs. Some commercial buildings just can't stand a power loss for any length of time.

Application of current-limiting fuses to existing feeder circuit breakers can provide needed interrupting capacity. A fuse-breaker combination in a panelboard protects main circuit breaker or a circuit breaker feeding single load.

Use of current-limiting fuses is not limited to large air circuit breakers. Thinking is applicable to molded case breakers as well. In the latter category five frame sizes are involved with continuous ratings of 15 to 600 amp, 600 v and under range.

key factor in 460-v office buildings

much more thought to circuit protection at the higher voltage.

Fault protection at the higher voltages was theme of paper by W Deans, J De Lellis and A J Bisson presented at AIEE Winter General Meeting in New York, Jan 31, 1956. In simple terms, their paper, *Fault Protection in Large Buildings Supplied by 265/460 Volt Networks*, preached the gospel of first calculating fault currents at various points throughout the building, then selecting available equipment to economically control these currents. Authors pointed out there are proven methods for coping with high fault currents: (1) circuit breaker big enough to handle maximum short-circuit current (2) smaller breaker along with some means for limiting fault current (Oct 1953, p 103). Typical ways to limit fault currents include fuses, or a combination of these methods.

Circuit breakers for 460-v circuits had a face-lifting, rating-wise, early in 1955. For several years, circuit-breaker manufacturers through NEMA had been jointly probing the feasibility of stamping a more realistic interrupting capacity rating on large low-voltage air circuit breakers (April 1955, pp 96-97). Until that time, IC rating leveled for 600 v was the recommended value to use at 240 and 480 v.

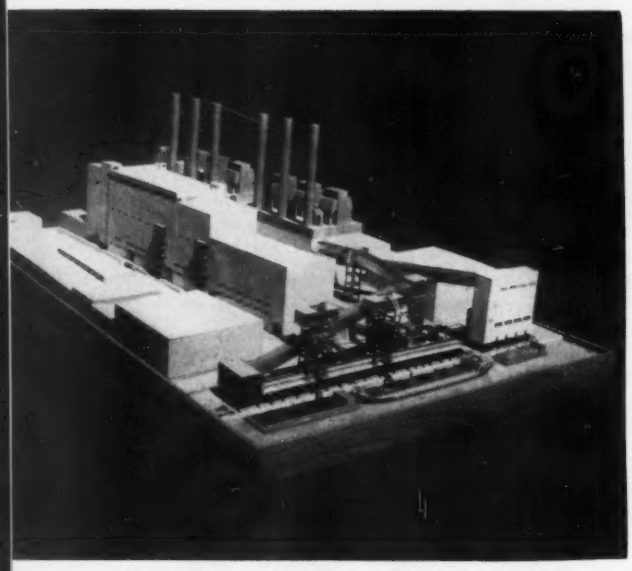
Breaker designers have long suspected IC ratings can be boosted on 600-v air breakers applied at the lower voltages. Often rerating means sanctioning use of less costly breakers in low-voltage applications. And the low-voltage field is really big: 90% of all breakers applied in commercial buildings and industrial plants are at 480 v and below. Today the NEMA standard full-load current rating of breakers varies from 225 to 4000 amp while IC ratings lie between 15,000 and 100,000 amp at 600 v; 25,000 and 100,000 at 480 v; 30,000 and 150,000 at 240 v. Manufacturers can furnish special breakers with an interrupting ability greater than the NEMA rating.

Circuit impedance of the supply affects magnitude of any short-circuit current. But supply impedance is generally determined on a basis other than short-circuit current values. Big factor here is the kva capacity of feeder transformers and their percent impedance. In a metropolitan area serving 120/208 v, transformer impedance may vary from 4 to 5%. Selecting 7% impedance transformers on a 265/460-v setup gives about the same percent voltage regulation as with a 4% unit at the lower voltage. Going beyond 7% trims back available short-circuit current, but voltage regulation is unsatisfactory. Likewise, swinging below 7% improves regulation but at the expense of higher available short-circuit currents.

Current-limiting fuses are increasing in importance as 265/460 v becomes more popular. A high-interrupting capacity fuse is designed to open a short, often within the first-quarter cycle (October 1953, p 107). An ordinary NEC fuse may require a current ratio of 100 (available current to rated current) before becoming current-limiting. On the other hand, the true current-limiting fuse often does its current-limiting job with a ratio of 12.

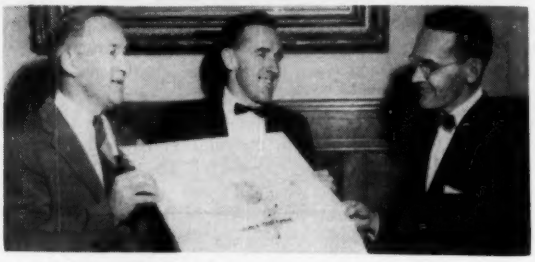
What's the difference between a true current-limiting fuse and a high-rupturing-capacity fuse? Well, both have high interrupting capacity. But the current-limiting fuse acts fast to limit current: High interrupting-capacity fuse merely opens the circuit safely when current is high. But latter does not reduce let-through current magnitude. Fuses with a current-limiting label are available in a range of sizes to 6000-amp full load. They have been tested successfully on circuits where available current is 500,000 amp.

Breaker-fuse unit was recently introduced (October 1955, p 166), combining a current-limiting fuse with a standard circuit breaker. This is another tool in the circuit designer's hands when laying out a 265/460-v scheme. Here both units are fitted into a common molded case no wider or deeper and but a few inches longer than standard comparable-size breaker. Standard circuit-breaker section of the unit contains a conventional thermal trip for minor overloads and an instantaneous trip for all faults below extreme short circuit.



74th ST POWER PLANT of the NYC Transit Authority, one of last year's award winners. The J G White Engineering Corp, New York, N. Y., are the consulting engineers

FAR WEST. 1955 award is handed over to H A Smith, chief plant engineer at Convair's San Diego, Calif. plant. Jim O'Connor (*standing*), *Power's* Managing Editor, makes award



EAST. Assoc Ed. Ty Hicks, presents 1955 award to E T Rudman, *left*, chief plant engineer, and D S Williams, *center*, president, Graton & Knight Co, Worcester, Mass.

To recognize meritorious achievement and to spark smart modernizing...

Power invites you to enter the 1956 Program

■ **Highest production levels in our history present industry with one of its biggest challenges yet: Modernize the power services to meet booming production-line needs**

■ **Is industry meeting this challenge? Judging from the enthusiastic reception of *Power's* 1955 citation program, the answer is a resounding yes**

■ **Last year's citation winners invested some 50 million dollars to bring their plants into line with today's best practices. And, on the average, investment payout time figures to be less than four years**

■ **Continuing *Power's* policy—to stimulate modernization planning—we now announce the 1956 Modernization Award Program**

AN OPPORTUNITY to help others as well as yourself. If you've helped your company, or one of your clients, to modernize one or more of the power services during the past two years (1954 and 1955) here's an opportunity to have your accomplishments recognized. By entering the citation program you'll have a chance, through the pages of POWER, to show other potential modernizers how results were achieved. In addition, plants as well as consultants selected for outstanding accomplishment will receive a citation that may be proudly displayed.

WHO IS ELIGIBLE? Industrial, institutional or utility plants that have modernized any or all of the power services—boiler plant, generating equipment, electrical distribution, building or process heating, air conditioning, refrigeration, compressed air, mechanical-power transmission or water services—may enter. Or, consultants may make a joint entry for themselves and their clients.

Plants may be steam, diesel or hydro. And small installations will get the same consideration as large ones. So don't make the mistake of holding back because you think your entry can't compete with those of larger plants.

MIDWEST. Ford Motor Co and the Kuljian Corp, consulting engineers, joined forces to receive 1955 award from Assoc. Ed. Howie Kallen, center, for Rouge plant project

# of Modernization Awards

HOW WE JUDGE. POWER's editors, assisted by advisory experts, do the judging. Emphasis will be on improved reliability, operating gains and dollar savings resulting from the modernization—and on the ingenuity with which problems were solved.

WHO MAY SUBMIT ENTRIES? Most will come from power-service staffs and consulting engineers. But we'll welcome leads from anyone in the field who knows of a meritorious modernization project.

IT'S EASY TO ENTER. By answering the streamlined questions on our simplified entry blank you can quickly give us data we need to know.

DON'T PUT IT OFF. Sit down right now and send for an entry blank. For details of how to enter, see column at the right.

Remember, no matter how good a job you've played a part in, the project can't receive an award unless you enter. By entering now you'll have a chance to win lasting evidence of achievements by you and your associates. And you'll be giving a helping hand to fellow engineers throughout the country.

How to submit entries

1. Entries will be received from plants of any type, of any size, in any service, in which a modernization program was completed during the calendar year 1954 or 1955. Modernization may cover the entire power-service installation or any major part of it.

2. Entries may be made by any responsible member of a plant's power-service staff, or by a consultant for his client.

3. To enter, just say "I'd like a 1956 Modernization Award blank" and address your card or note to:

Modernization Award Committee
c/o POWER
McGraw-Hill Publishing Co, Inc
330 West 42nd Street
New York 36, N. Y.

4. The entry blank you receive will contain a series of streamlined questions designed to make it easy for you to tell us about your modernization job and its results.

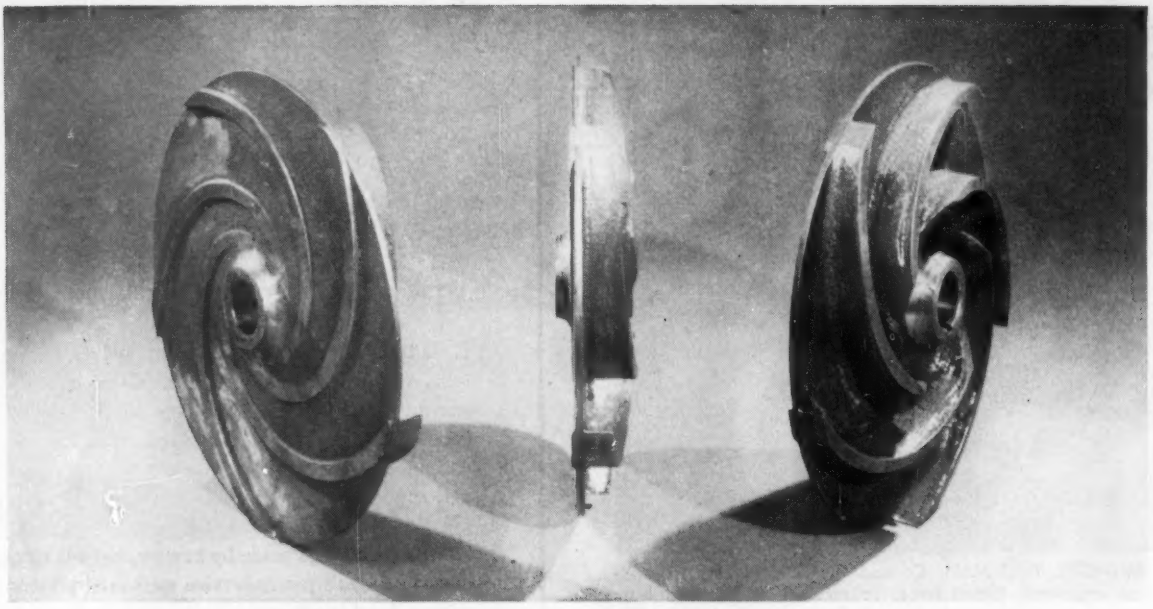
5. In general, the kind of information we ask for will tell us (1) what was modernized (2) the principal reasons for modernization (3) what results were obtained (4) the unique features of the job, and (5) what unusual or difficult problems were solved.

6. Entries will be accepted to May 15, 1956.

7. Announcement of award winners will be made in the 1956 Mid-September *Modern Plant* issue.

8. Arrangements for presentation of the awards will be made to suit the mutual convenience of the recipients and the POWER staff.

9. There is no set number of awards. It is our intention to recognize all plants that, in the opinion of the judges, have carried out modernizations of outstanding merit.



1 Back, edge and front of a single-suction single-stage end-suction process-pump impeller, showing eductor and pump vanes. Note eductor-vane thickness

Specify eductor vanes to slash cost of end-suction process-pump maintenance

Modern process pumps are built with an eye toward maintenance. Take advantage of the many new features by getting to know what they are, what they'll do. Here are details on one benefit

By C R McFARLAND, *De Laval Steam Turbine Company*

► SOME ENGINEERS overlook the cost of stuffing-box maintenance, feeling that the price of packing material is relatively small. But take a closer look and a different picture emerges.

True costs must include the price of new shaft sleeves needed to replace worn ones, the cost of packing and of labor for repacking pump stuffing boxes. For a plant with a large number of pumps the labor cost can be extremely high. The downtime itself may be costly for some applications.

Some pumps use mechanical seals, especially in applications involving high pressures, toxic or flammable fluids. But most services today are not critical enough to justify the higher costs of this type of sealing. By far, the conventional packing methods exceed all others.

Consider the countless number of pumps handling brines, caustics, water and other liquids throughout industry. When you realize that most of these have conventional packing, the expense involved for labor to perform stuffing-box chores is evident. Any reduction in the required frequency of repacking will free much valuable time for other maintenance chores.

Why packing? To prevent liquid leakage out of a pump along the shaft where it passes through the casing, packing is used. To perform its job, the packing must be compressed enough to counteract the fluid pressure existing on the internal end of the stuffing box. This is done by taking up on the stuffing-box gland nuts until only the desired amount of leakage for lubrication and cooling is obtained.

Compressing the packing in the box squeezes it around the shaft to resist the fluid flow outward—this also sets up some resistance to the turning of the shaft. Resistance to shaft rotation means that heat will be generated in

the stuffing box. To prevent this heat from damaging the packing, a small amount of leakage past the shaft is allowed. This leakage also prevents scored or worn shaft and sleeves. Heat generated in the stuffing box is one of the mechanical losses in a pump which, along with disk friction and bearing losses, reduces pump efficiency.

The greater the pressure at the internal end of the box, the greater the counteracting compression, the number of rings, or both. Stuffing boxes in single-stage double-suction pumps are subject to the suction pressure, which is usually less than the pressure the pump itself develops. With this lower pressure to seal against, the packing and shaft sleeves will wear well with proper care and adjustment.

End-suction pumps used for general chemical and lower-capacity water applications are often the overhung design with the stuffing box on the discharge side of the impeller, Fig. 2. This means the stuffing box has suction pressure, *plus* the pump discharge pressure acting on its internal end. As a result, end-suction pumps require greater counteracting packing pressures than double-suction pumps.

Eductor vanes, Fig. 1, are formed on the back of end-suction impellers for process pumps. Their purpose is to reduce the pressure acting on the impeller end of the packing box.

The eductor vanes follow the general contour of the actual pumping vanes, but their tips are advanced slightly ahead of the pumping-vane tips. They have a pumping action, creating a low-pressure area at the impeller hub and stuffing box, and a high-pressure area at the periphery of the impeller. Fig. 2 shows the typical pressure gradient created at the back of the impeller.

The slight advance of the eductor vanes makes the pressure developed on the impeller-rim back equal to or greater than the pressure developed by the pumping vanes. This sets up an effective barrier to the action of the pump discharge pressure on the stuffing box. Low-pressure area created at the impeller hub and stuffing box is only a fraction of the discharge pressure, increasing the life of the packing, shaft or sleeve, and reducing the amount of heat dissipated in the stuffing box.

Shop tests. Extensive tests of several styles of end-suction pumps without eductor vanes were conducted to determine basic data for comparison with pumps fitted with eductor vanes. Tests were made over the entire head and capacity ranges of the pumps while pressure readings were taken at the impeller hub by means of the tap, Fig. 3. Another tap, not shown, was located 180 deg around the shaft.

Results with eductor vanes showed a consistent pattern for several types of end-suction pumps tested. Fig. 4 shows that at the no-flow condition, the vanes reduced stuffing-box pressure to 20 ft, compared to a shutoff head of 80 ft. The reduced stuffing-box pressure is 25% of the pump-discharge pressure.

As pump flow increases toward the rated capacity, effects of the eductor vanes become more pronounced. At 900 gpm and 72-ft head, the vanes reduce the stuffing-box pressure to only 6 ft, or 8.3% of the discharge head. At rated capacity the stuffing-box pressure is zero.

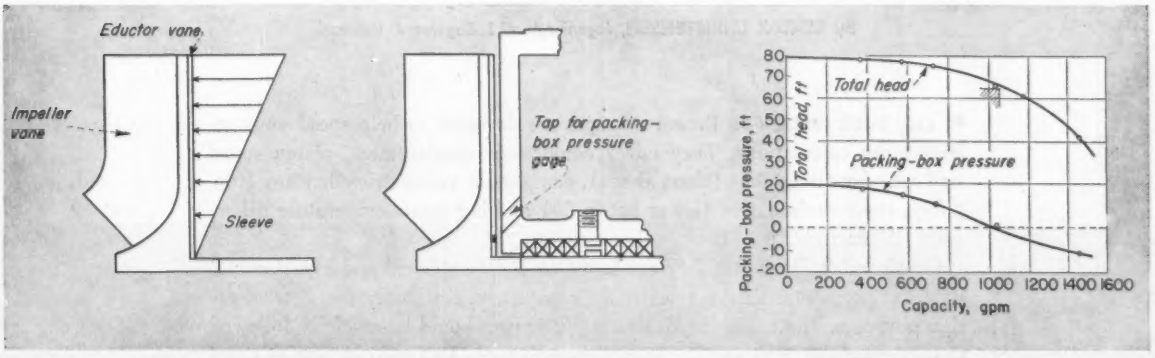
These tests were made on new pumps before wear occurred—that is, before the impeller face wore. The open-impeller pumps used in the tests can handle liquids carrying some solids in suspension. The solids can be sufficiently abrasive to wear the pumping-vane edges. To compensate for this wear, the rotor may be moved toward the suction nozzle to take up the excessive clearance created.

Clearance behind the impeller is increased when it is moved ahead. To simulate impeller wear, the pumping-vane edges were ground down and new readings taken. Grinding was continued until 3/8 in. had been removed from the vane width and a slight change in capacity at a given head became apparent. In practice, this is the point at which a replacement impeller would be ordered so the pump could be restored to its original operating characteristics during the next normal maintenance period.

As might be expected, the increased clearance between the back of the impeller and the casing reduced the effect of the eductor vanes in lowering stuffing-box pressure. But the pressure curve obtained parallels the original one for a new pump and shows that the pressure is held to 20% of the pump discharge pressure at its rated design point.

Solids in suspension cause less trouble when handled by a pump having eductor vanes because fewer particles find their way into the stuffing box where they lodge between the packing and shaft sleeve. This further reduces the wear and maintenance.

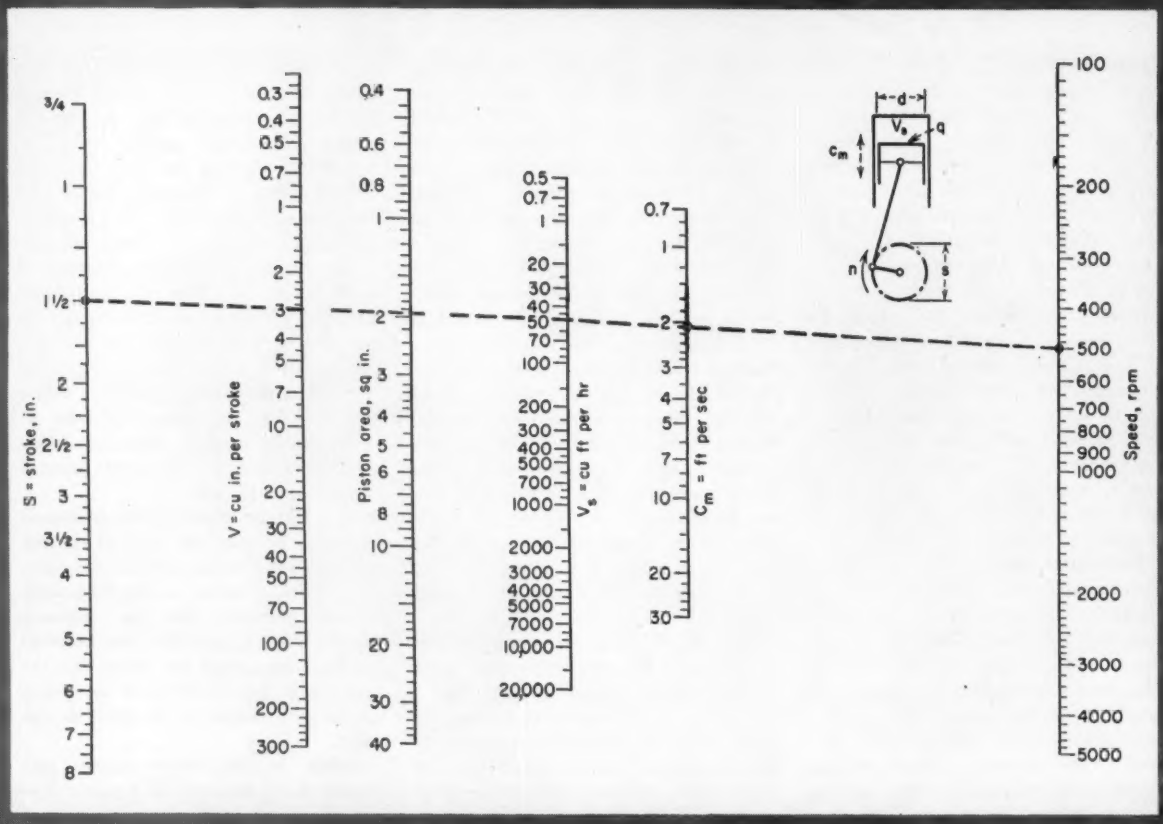
Eductor vanes are not new. Over the years, various designs have been tried with different degrees of success. Stuffing-box maintenance was considered important enough to warrant continuing effort to find an effective vane design. Operating experience with the eductor vanes described here has shown considerable improvement in increasing the useful life span of the packing, shaft and shaft sleeves. As a result, pump maintenance costs are lower.



2 Pressure gradient on back of impeller shows reduction at hub and box

3 Pressure tap for finding effect of vanes. Another tap is 180 deg away

4 Stuffing-box pressure and its relation to the head developed by pump



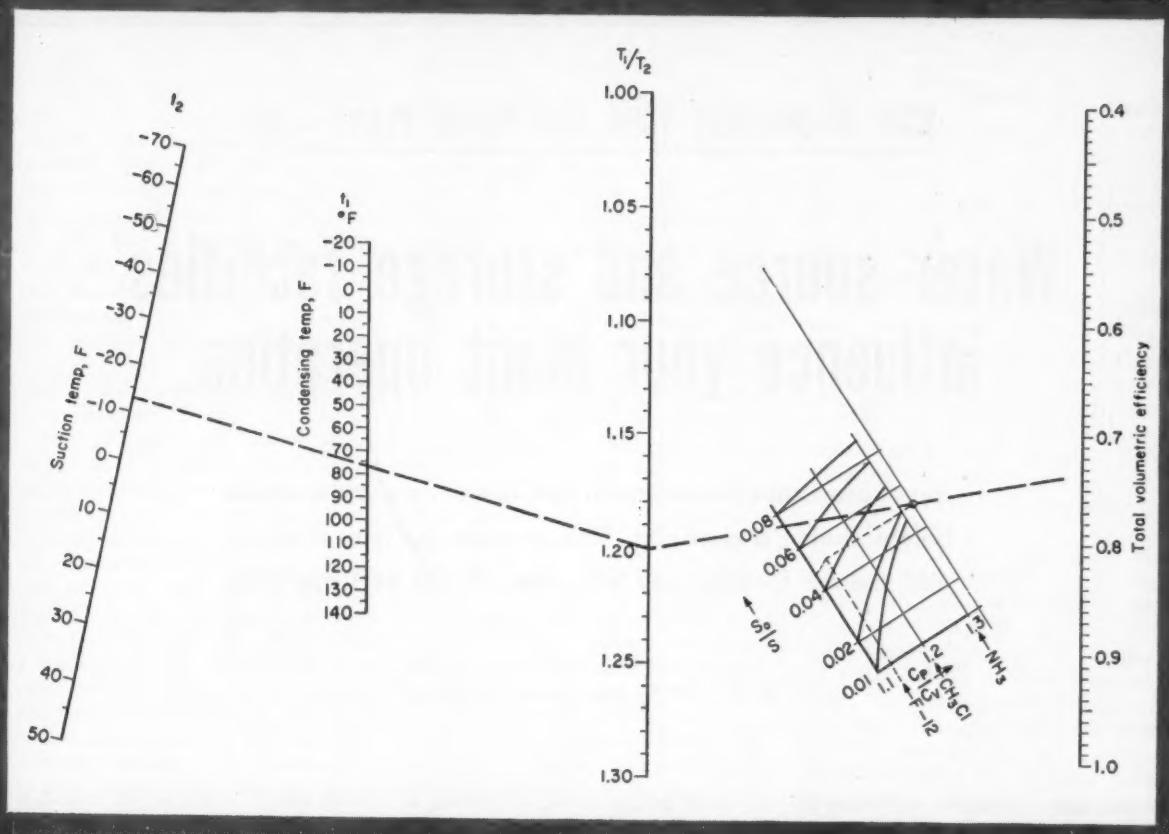
4 charts to speed your refrigeration design and performance calculations

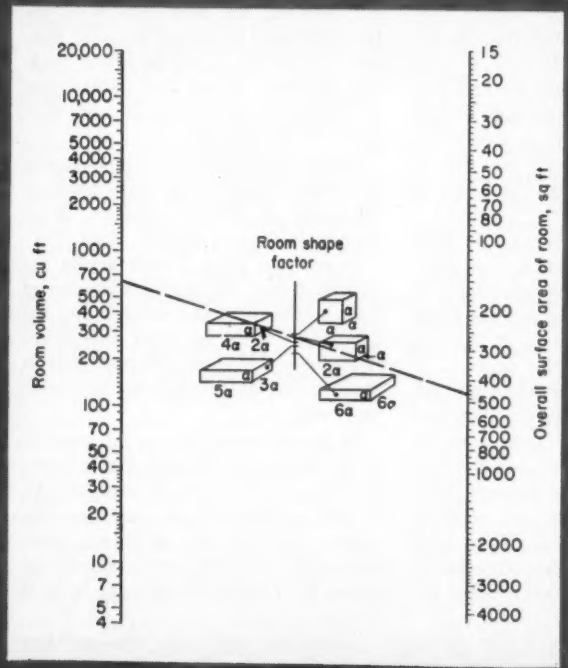
By **BENDIX CHRISTENSEN**, *Ingenier M af I, Bagsvaerd, Denmark*

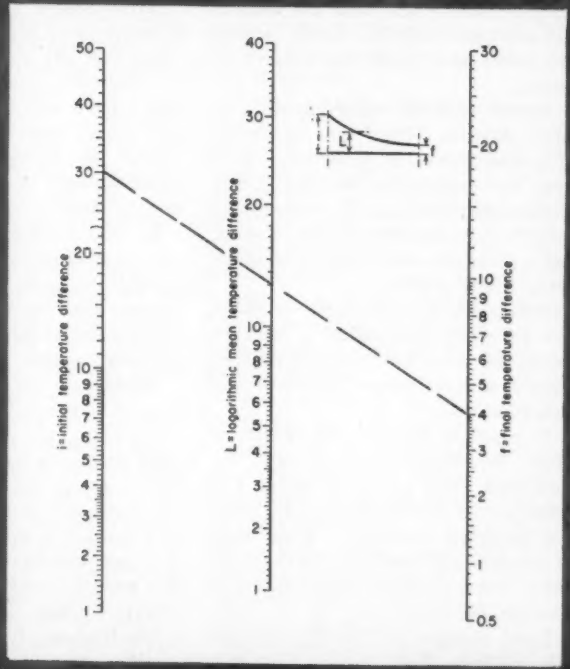
► THE FOUR CHARTS on these two pages are designed to help speed your refrigeration calculations. They cover compressor displacement, piston speed and cylinder dimensions (chart above), compressor volumetric efficiency (top, p 89), room-surface area (lower left, p 89) and log mean-temperature difference (lower right, p 89).

Developed in Denmark, they are based on both empirical and experimental data. Numerous tests have verified their accuracy, suitability for general design purposes. The examples illustrating their use should be carefully followed as they show the large number of variables that can be found by one or more solution lines.

(*Continued on page* 194)


T_1/T_2
t_2
Suction temp, F
t_1 °F
Condensing temp, F
1.00
1.05
1.10
1.15
1.20
1.25
1.30
0.08
0.06
0.04
0.02
0.01
v_1/v_2
1.1
CF_2Cl_2 – F–12
CH_3Cl
NH_3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Total volumetric efficiency


Room volume, cu ft
Room shape factor
Overall surface area of room, sq ft
4a
2a
5a
3a
6a
6a


i = initial temperature difference
L = logarithmic mean temperature difference
f = final temperature difference

HOW TO ORGANIZE YOUR NEW POWER PLANT — 21

Water source and storage facilities influence your plant operation

Here's practical information on how to size up a water source before picking a plant site. Also, data on the type of intake and storage facilities you will need for the best operation

By D C SWIFT, *Ebasco Services Incorporated*

► THE MOST IMPORTANT water uses in a steam power plant are condenser cooling, boiler makeup, bearing and process cooling, fire protection, sanitary purposes, drinking. Each use requires certain characteristics, but in general the purer and cooler the supply, the better.

Source of water supply depends on plant location. Plant can use water from rivers, streams, lakes, ocean, wells —or any combination of them. Quantity and characteristics of water supplies are often all-important factors in selecting a plant site and determining equipment characteristics.

Before making a final site selection, get as much information as possible on typical water analyses, and estimate costs of water-treatment investment and operation.

If plant is near a lake, ocean or river, investigate level changes, ice formation, wind and wave action, possibilities for recirculation, and weed, fish or debris conditions. When using a stream or well, consider also the quantity of water available during minimum flow periods.

Level changes are usually most severe on large flashy rivers. This generally means a high and expensive water-intake structure with seal wells in the outlet line to prevent carrying too high vacuum on condenser outlet.

Other expenses may include constructing a high fill or flood wall to protect the plant during floods, or building a long intake and discharge conduit for the circulating water if the plant is some distance from the river.

River plants usually require (1) booms to keep trash away from intake structures (2) intake screens or bars (3) traveling screens and baskets (4) fine screens and (5) stop logs to permit tunnel repair or inspection. Discharge line should run down river a short distance to reduce possibility of recirculation.

In cold climates, carry a line back to the intake-screen chamber to allow enough warm-water recirculation to prevent the intake screens from icing. If river fluctuations are great, the cost of intake screens, etc, may be high.

Lakes and open ocean shores generally have no particular flow direction past the plant. Take water from a rather deep stratum so it is as cool as possible. Outlet should be some distance from the plant and at the surface, so there is a maximum of mixing. Water level does not usually fluctuate very much. But wave or ice action may damage the intake.

On fresh-water lakes in the colder sections, provide a recirculating line to keep ice off the intake screens. Dirt and debris in the water are not usually as troublesome as on a river, but weeds, fish and ice may cause difficulty.

Water available during dry seasons often restricts ultimate plant capacity. USGS records can give you river-flow figures covering a period of years for most U.S. rivers and streams. Sometimes you can take advantage of diversity between low flow periods in the river and maximum load periods; also, river temperatures may be low at peak-load seasons. These two factors may permit you to install slightly more than calculated capacity.

Modern high-pressure turbine-generators usually need about 1 cfs condensing water per 1000-kw capacity. A reheat cycle reduces this by about 10%.

If you can place a weir across the stream, pump the used cooling water back up the river, and spray it over the dam. This cools the water and makes it available for reuse. If river flow is inadequate, use a supplementary cooling tower.

In an emergency, reduce the quantity of water passing through a condenser, possibly to one half of normal. Although backpressure and water rate increase, the loss in maximum plant capability probably won't exceed 3% unless inlet water temperature is quite warm.

If the lake supplying cooling water is small, water temperature may rise. Two to three acres of water will care for roughly 1000-kw capacity. In favorable locations, you can take water in at one end of the lake and return it near the other end. This makes lake surface more effective for cooling.

Where there is no satisfactory lake, ocean or river water supply for condensing service, cooling towers or spray ponds are often used. The water temperature increases, and pumping water and running the fan take more power. So heat rate of cooling-tower plants averages 2 to 4% higher than for comparable stations using river water for condensing. Evaporation, blowdown and windage losses approximate the quantity of steam being condensed. But you can usually get enough makeup water from wells.

State geological departments or natural-resource boards may supply data on water-bearing strata in which wells can be developed. Reputable local well-drilling companies may also supply useful, dependable information on the probable type and quality of water available at the site being considered.

Wells of the same depth and within a few hundred feet of each other often show marked differences in capacity and kind of water produced. It's usually desirable to sink test wells to try to determine the most favorable sites. Up to about 1000 ft, depth does not affect total water-supply cost too much. Pumping equipment, motors, power supply, wiring and pipelines make up the bulk of the cost. Well depth affects these items but little.

Water from shallow wells is usually cooler (about the yearly average atmospheric temperature) and contains less dissolved solids than water from deep wells. The water level and amount of drawdown during pumping affect the pumping cost. Deep wells are often free-flowing at light loads, but the longer well casings increase drawdown under load as compared to shallow wells. Also, treatment costs are likely to be higher.

Install depth-gage lines in wells so you can check and record static water level and well drawdown. This helps determine water-table level and condition of the well screen and surrounding sands. It is also advisable to have some means of determining water flow. An orifice is simple and satisfactory.

Put wells on test, discharging to waste for a period before putting them in regular operation. Control pumping rate carefully so an excessive water flow will not spoil the sand-filtering medium that forms around the well screen. The pumping also stabilizes water quality.

Pumps for wells are of several types, including reciprocating cylinder, air lift, water jet and submerged centrifugal. The submerged centrifugal is most often used for power-plant work. Motor may be either (1) on top of the ground with a long shaft connecting it to the pump, or (2) encased in a waterproof housing that is installed, along with the pump, below the lowest expected drawdown.

With the long-shaft centrifugal pump, take care that pump operation does not unscrew shaft section couplings. If this happens, the pump internals or top casing may be broken by the shaft thrust as it lengthens, compared to the pump casing. This happens at once if motor turns the wrong way.

If pump reverses rapidly when shut down, because water in the pipe drops back into the well, shaft may tend to unscrew. So it's advisable to install a check valve at each pump discharge. This slows down reversal at shutdown time and prevents reverse flow if another pump is discharging into the same header.

If discharge line is long, use either a very fast or a gradually closing valve or a surge chamber. This eliminates severe water hammer in the lines as the long water column stops.

Water storage protects against loss of pumping power, pipeline failure, outage for equipment repairs, well- or river-water supply shortage. Use metal or concrete tanks, either elevated or at ground level, a basin or reservoir of earth or concrete, or a lake for storage.

Steel tanks should be smooth and free from irregularities inside. All surfaces should be covered with some form of waterproof paint or coating. The smooth surface makes it much easier to maintain the coating.

Sometimes steel tanks are protected by highly galvanic electrodes or by an electric potential system. Tank should be watertight and of metal heavy enough and properly reinforced to withstand expected hydraulic pressures.

Provide means for water inlet, outlet, overflow and complete drainage. Outlet should be raised slightly above the tank bottom to keep dirt and sediment out of pipes. Drain should be at the largest point and preferably in a sump so dirt may be readily hosed off the tank sides and bottom and out the drain.

Provide gage glasses or level indicators on tanks where water level is not readily visible, and install high- and low-level alarms if damage may result from water becoming too high or low. You can control tank level automatically with float valves, float-controlled pumps or an altitude valve.

An altitude valve maintains tank-water level at a given height as long as supply pressure is above tank pressure. When it drops below tank pressure the valve opens. Water then flows out of the tank to help keep up the supply pressure to the system on which the tank normally "floats."

In cold climates, exposed tanks may freeze. But in most locations ground-water temperature is considerably above freezing. Pumping some water to waste out the tank overflow usually prevents freezing. As an alternate, you can partly drain and refill the tank. This is effective but requires more attention. Another system uses heating coils in the tank water.

As a layer of ice forms inside the tank, it provides a medium of insulation that markedly reduces the freezing rate of the rest of the water.

Wood tanks are not subject to rust, but rot and decay in time. They are perhaps more prone to leak than a good steel tank. They give somewhat better insulation against freezing.

Concrete tanks do not suffer much from corrosion. But they may contaminate very pure water, like condensate, with silica and calcium. They are also prone to crack, and will leak at cracks and joints. Temperature changes caused by incoming water usually cause the cracking. So cracks that are repaired tend to reopen.

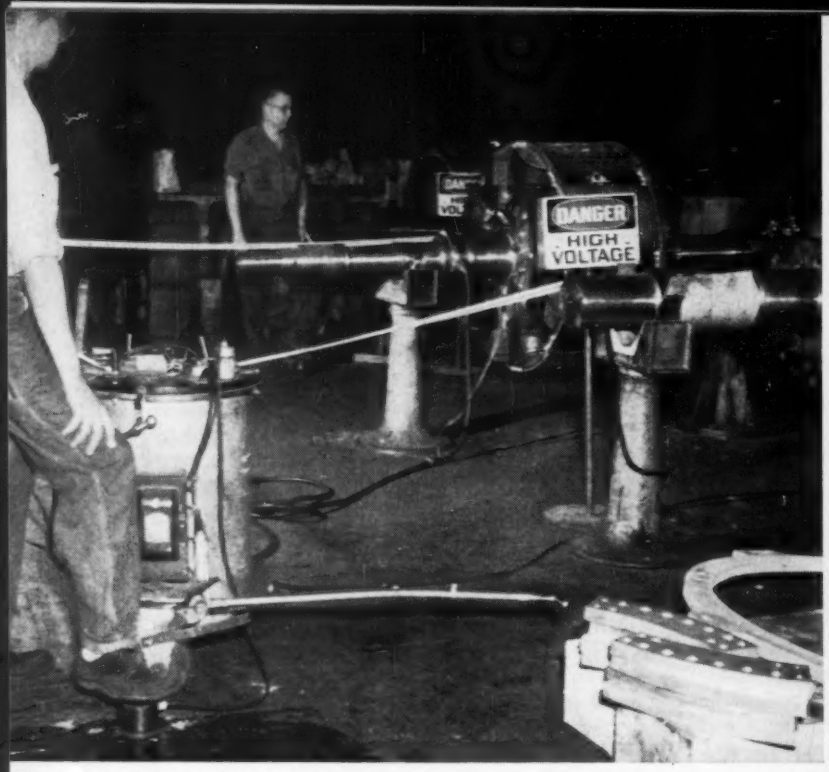
Ponds and lakes may be natural or man-made. Some form of dam and spillway is almost always required. The dam must be firmly keyed to the adjoining hillsides. If it's of earth it must be relatively flat, and made of rather impervious well-packed material. The spillway must be large enough, and constructed so maximum expected floods can be carried over the dam without damage or washing of the spillway, dam, or reservoir wall. If you expect heavy wave action, you may have to riprap dam and lake shores.

Algae and weed growths may have an adverse effect on quality of water drawn from a lake or reservoir. Light stimulates the growth of most types of algae. This is one reason why water reservoirs are often covered. The other big reason is that you get less surface dirt and contamination.

Water systems can be classified as once-through, recirculating in a closed system with cooling by conduction, or recirculating in an open system with cooling by evaporation.

Because of the relatively large quan-

(*Continued on page* 196)



TEMPORARY TEST SETUP is marked by red and white tape, danger signs, blinking lights. Two men make test; each must step on foot switch to close control circuit

PERMANENT CAGE. Operator must close interlocks and step on the foot switch

As a plant engineer, you may be called on to set up a high-voltage test enclosure. Whether the setup is permanent or temporary, you'll find valuable info in these tips from a top electrical manufacturer

Check these 11 points in planning a

► WHEN YOUR PLANT needs a high-voltage test station, you want to design it to do a good production job. It must satisfy the functional requirements of the operation. And for safe, efficient use, the setup eliminates as far as possible the chance of human failure or breakdown that leads to accidents.

This means (1) isolating electrical hazards within interlocked enclosures and (2) providing devices that automatically remove power and eliminate hazard in an equipment failure or malfunction. These thoughts were presented by J L Sullivan, Safety Engineer, General Electric Co, at the Greater New York Safety Council's 25th Annual Safety Convention.

There are two general types of enclosure: permanent and temporary. Permanent enclosures are made of metal screen. Temporary ones are set up with red-striped white tape that is used to mark and to isolate the area for testing.

The same general rules apply to both types. See panel on facing page for a quick summary, then read details below.

1. In any size enclosure, input power has to be wired through a primary disconnect. Test people at work in the area must be able to see it easily.

2. All non-current-carrying metal parts of a high-potential system, like transformer tanks and regulator handles, must be grounded. This provides a low-resistance path to ground if a fault ground develops in the system.

One end of the high-potential transformer's high-voltage winding must be grounded. So must the equipment under test. This affords a return path between the high-voltage winding and the unit under test should the unit fail.

3. Interlock all gates, doors or access points to the enclosure by a method that breaks the circuit mechanically as well as electrically. Interlock circuit is wired through a plug and receptacle in one common device. Test personnel must check the interlocks at the beginning of each work period.

The interlock must break both sides of the line except where one side of it is grounded. In this case, it is sufficient to have the interlock break only the ungrounded or "hot" side of the line.

Control circuits must always be used so accidental grounding of one line will not cause the safety devices to become inoperative. The interlocks must always remove the high-voltage power, and should remove low-voltage power where possible. If this is not feasible, have the enclosure conspicuously posted, designating energized low-voltage circuits.

4. Use red flashing warning lights to indicate the test area. Two lights should warn every avenue of approach. Wire the lights so they are in parallel

For safe test-enclosure design, follow these suggestions

- **Build cage so no one on the outside can contact live parts**
- **Ground all non-current-carrying metal parts**
- **Use red flashing lights to indicate high-voltage test**
- **Post 'Danger—High Voltage' signs**
- **Wire input through a visible primary disconnect**
- **Armor or isolate high-potential input cable**
- **Put power sources and energized equipment inside cage**
- **Use interlocks that break all circuits mechanically and electrically**
- **Be sure all interlocks and safety devices fail safe**
- **For temporary enclosures, use foot switches to protect operators**
- **Never run one enclosure with power from another**

high-voltage test setup

and operate only when (1) there is a hazard in the area and (2) the primary disconnect is closed. Test personnel must assure themselves that everyone is clear before applying voltage.

5. Display "Danger—high voltage" signs at every access point.

6. Conductors other than ground connections cannot pass through, over or under the enclosure in a way that permits bringing power in or out of an interlocked area without full benefit of the safety devices.

For example, never run one enclosure with power from another. Then only the protective devices at the power-source enclosure would be operative. Anyone entering the second cage would be subject to electrical shock.

7. Where possible, enclose all equipment, power sources, etc, within the protective area. Separate low- from high-voltage circuits by grounded barriers, isolating transformers or by some other method to stop high-voltage feedback.

Instrument circuits extending from the enclosure must be within a panel or metal shield connected to it and grounded. Instruments connected to these circuits have to be within an auxiliary interlock or continuous enclosure. Where possible, use current and potential transformers on instrumentation.

8. In a small enclosure that people can't get into, see that you can apply the high voltage only when device is inside, with all gates or doors closed and interlocked. Operator must not be able to contact any live high-potential circuits.

9. If a man could get into the enclosure, but no one is allowed inside during tests, connect a foot switch in series with the interlocks. Then high potential can be obtained only when tester operates the switch outside the enclosure.

10. For a temporary setup, or in open areas, indicate the testing area with red-striped white tape.

Use foot switches for temporary enclosures—one for the operator, one for each assistant. Foot switches must be near the work under test and connected in series. Either operator or assistant can remove the high potential in an emergency.

If unit under test is small and test equipment can be placed next to it so operator has complete and safe control, you need only one foot switch.

11. If voltage permits, the high-potential cable from the transformer high-voltage winding to the unit under test must be armored. This guards against possible contact with control cables. If you can't use armor cable, keep the high-potential line separate from all control cable, and be sure it is included within the enclosure.

The basic safety objective in electrical testing is to prevent personnel from contacting live electrical parts. This objective is best accomplished by isolating the hazard so power is automatically removed from the equipment and remains off when a hazardous part of the circuit is exposed.

Use adequate safety devices and procedures to isolate hazards in all areas. This means following the same safe practices in laboratory and development work as in production.

Respect for electricity must be developed and maintained through training before a man can accept responsibility for his own safety in a testing area. A man must appreciate what an interlock is and does, if he is to resist the temptation of short-cutting it.

Training can be tailor-made to your own needs. GE breaks it up this way: First, man reads rules and regulations, studies diagrams and explanations. Second, he works as a helper or observer with a more experienced tester. Third, he performs responsible parts of test operations with experienced man acting as his helper. Fourth he is on his own, subject to periodic check.

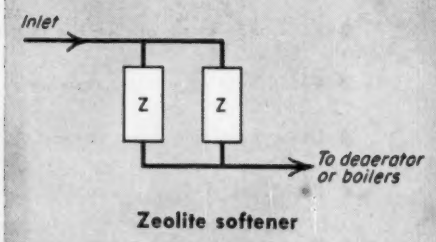
All the men must be familiar with the guards, interlocks, safety devices, methods of operation, etc. The whole system loses meaning if men don't understand the need for it.

There are several other procedures and practices to follow. These include safety glasses, tag-out procedures, tape barriers, check sheets, artificial-resuscitation practice, and especially adequate job training for each tester.

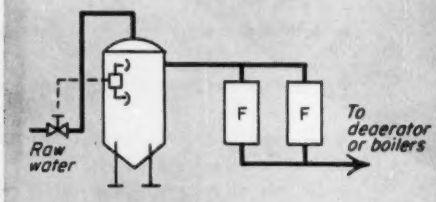
Daily dividends . . .

from feedwater treatment are yours, and at little cost, by simple changes in your system. Less costly chemicals, reduced blowdown, increased capacity pay off. Here's how

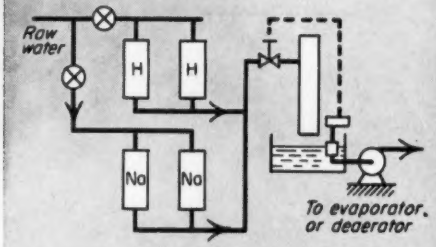
Your system?



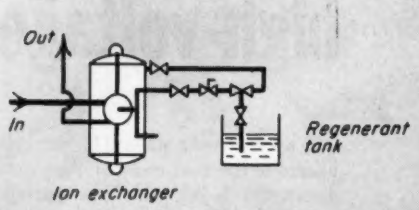
Zeolite softener



Hot lime soda



Split-stream dealkalizer



Manual demineralizer

► REPLACE PRESENT ZEOLITE with a styrene-base zeolite; get higher unit flow rate with fewer regenerations for equal volume of treated water.

Salt-regenerated anion exchanger avoids need for complex, costly acid-handling equipment to lower bicarbonate alkalinity. Less free CO_2 liberated in the steam and dissolved in the condensate means less corrosion of return piping, valves and traps.

Hot-process water softeners usually produce 45 ppm alkalinity and 20 ppm total-hardness water. Added phosphate reduces hardness to zero, but alkalinity runs relatively high.

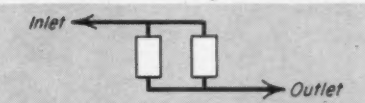
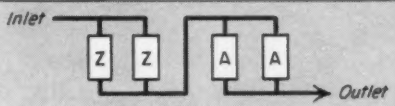
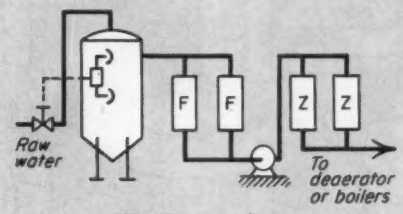
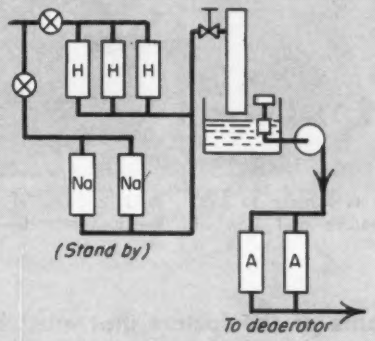
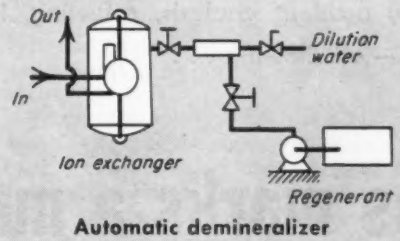
Install salt-regenerated hot-zeolite softeners after the filters. Lime-soften, at an alkalinity of 25 ppm, in the settling tank. Hot zeolite picks up residual hardness.

Change hot-process settling tank to sludge-blanket type. This helps remove silica and takes part of load off filters.

Savings: (1) Salt is cheaper than soda ash. (2) Boiler blowdown is reduced since feedwater contains less dissolved solids.

Split-stream dealkalizer gives low alkalinity, zero-hardness water, but leaves problem of some dissolved solids. Converting to demineralizer gives complete removal of these solids.

Demineralizer gives rated capacity at all times, eliminates evaporator whose capacity is fixed by boiler and turbine-

These low-cost changes . . .	give you this system . . .	and these benefits
1. Styrene-base zeolite 2. New subfill 3. New brine and inlet system	 **High-capacity zeolite**	Increased capacity Fewer regenerations Lower salt cost
1. Salt-regenerated anion exchanger	 **Anion dealkalizer**	Reduced alkalinity Less CO_2 in steam Lower chemical cost
1. Hot-zeolite softener 2. Brine regenerating equipment 3. Booster pump	 **Hot lime zeolite**	Lower chemical cost Lower alkalinity and total dissolved solids Uniformly soft effluent Less CO_2 in steam
1. Two highly basic anion units 2. Additional hydrogen-zeolite unit 3. Replace transfer pump in alloy construction	 **Demineralizer**	Dissolved solids reduced below 5 ppm Soluble silica to 0.02 ppm Makeup independent of heat cycle, plant load Improved plant heat rate Higher-quality steam Less outage for cleaning boilers and turbines
1. Motor-operated valve 2. Sequence timer and controls 3. Controls for chemical preparation	 **Automatic demineralizer**	Increased capacity Uniform water quality Reduced labor

By **ROBERT H MARKS**, *The Permutit Company*

generator operating rate. Ends worry over makeup shortage, or untreated water in boilers. Ends unavoidable heat-energy loss across the evaporator coils, improving plant heat rate.

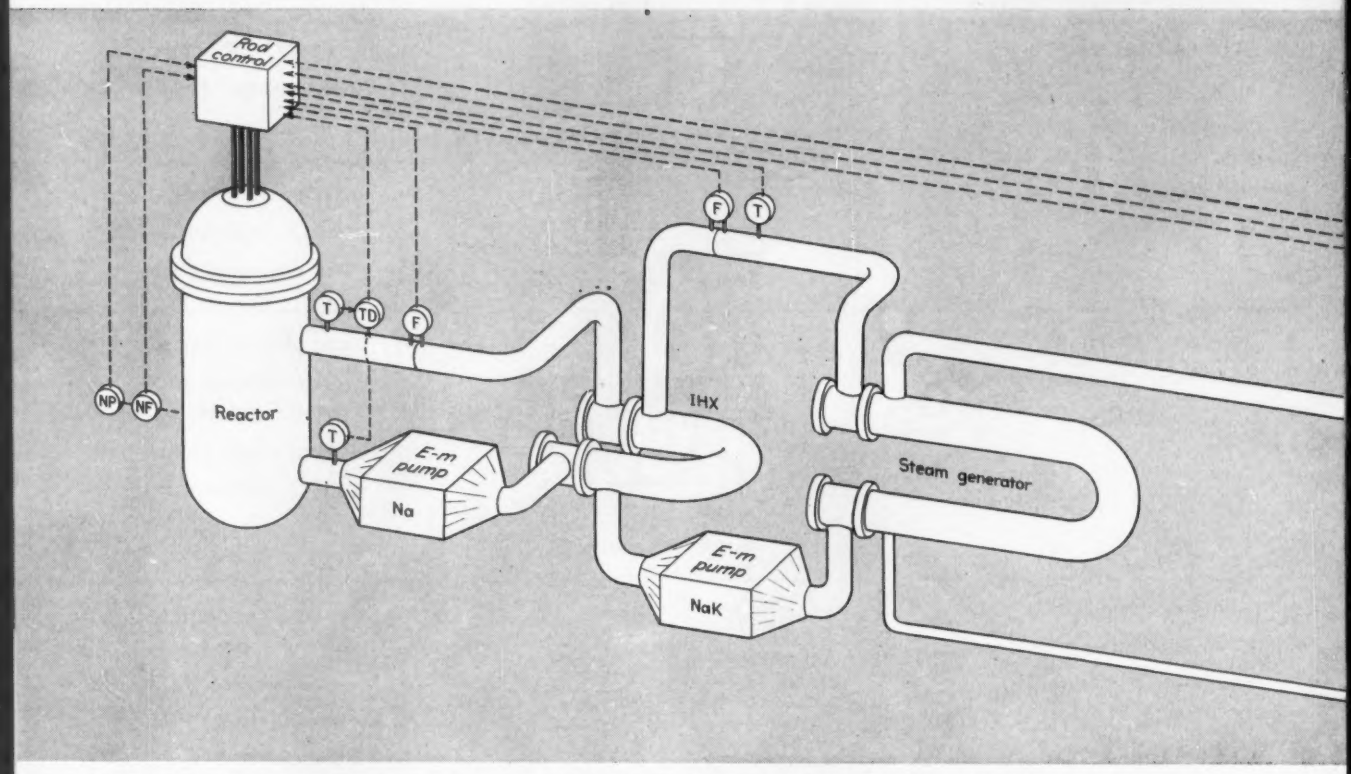
If feed is direct from dealkalizer to boilers, demineralizer gives better-quality makeup, better-quality steam, less blowdown. Big saving is longer operating periods between outages for cleaning boilers and turbines.

Complete regeneration of demineralizing system takes time—can't be done carelessly. Some plants handle job on rotating-shift basis, others as specific assignment. Operators, being human, may use shortcuts—prevent system from giving designed performance.

Automatic operation is not a cure-all. But it does give consistently correct regeneration, frees operators for other duties. Electropneumatic sequence timers ride herd on regenerating cycle, can be extended to preparation of the chemicals. Other controls, recently introduced, decide when regeneration is necessary and then take the system through the cycle.

Endpoint controls do away with need for time-consuming titration of effluent samples—insure that unit is not overrun.

Weigh advantages of modernizing by these methods against cost of new equipment. This, plus figures on chemical operating costs on your water supply, will point up actual savings.



1 Reactor rod control should be mainly responsive to load on main generator. Pressure, temperature and flow of fluid circuits should interlock with reactor control too. F—flowmeter; L—wattmeter; NF—neutron flux meter; NP—

Let's look at some of the factors that must be considered in designing and building a nuclear power plant — operation, control, safety, accident analysis, refueling, inspection, proposal analysis — all showing . . .

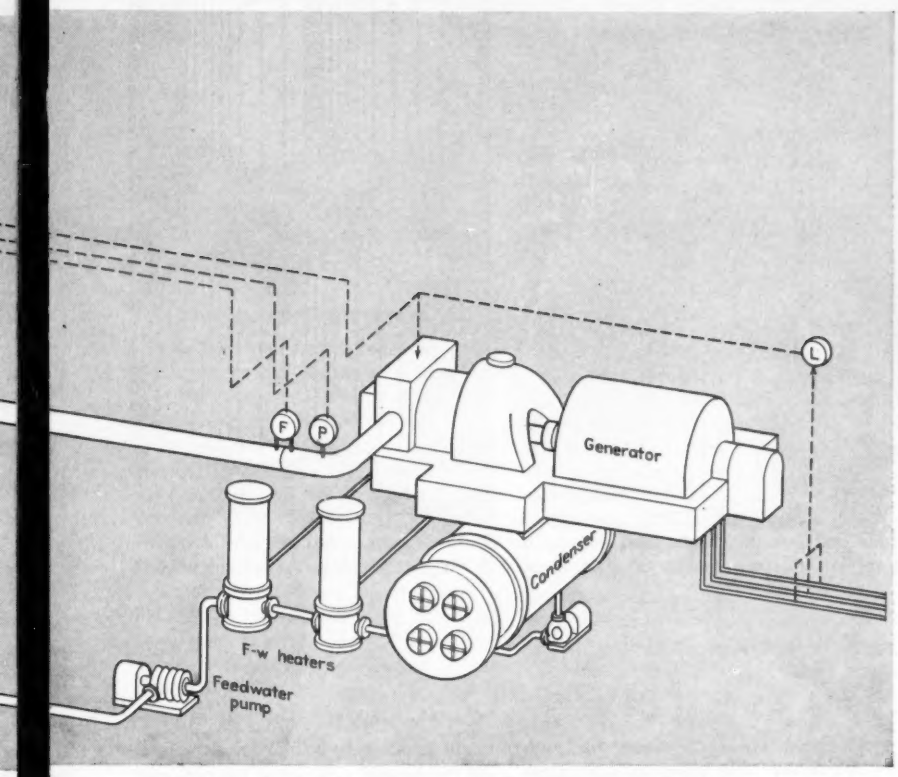
Thoroughness marks a nuclear design

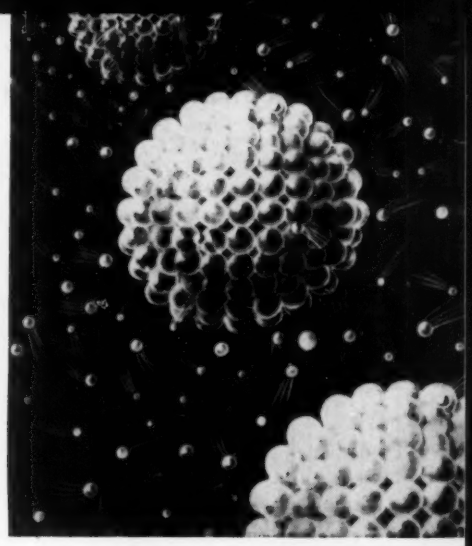
By **HENRY C SCHWENK**, *Henry Pratt Company*
and **ROBERT H SHANNON**, *United Engineers and Constructors, Inc*

► PROPER OPERATION of a nuclear power plant depends on many factors. The reactor must develop enough heat to produce the steam needed by the turbine to carry the load. To do this the reactor core must establish the proper level of neutron flux to cause fuel fissioning at the rate needed. The operator must know always the neutron multiplication period so the reactor never enters an activity level where it might run away and thus destroy itself.

Safe operation depends partly on keeping the reactor coolant outlet temperature below the safe maximum so fuel and structural materials will not be damaged. Reactor and coolant system stability depend on the coolant flow rate and the coolant temperature differential through the reactor. The steam-cycle operation aims, as in conventional plants, to maintain proper pressure, temperature and flow of steam at the turbine throttle. Behavior of the whole plant responds to the heat storage and cycle time of the coolant systems between reactor core and turbine inlet.

Ideally the reactor energy output should be in exact step with the electrical output of the generator. Some reactors do this—others need control rod adjustments to stay in step with the electrical load. Signals from steam





neutron period meter; P—pressure gage; T—thermometer; TD—temperature differential meter; other controls within each circuit, like pump, level units, not shown

pressure and flow and generator load can be sent direct to the reactor control system or they can act as anticipatory load-change adjustments, Fig. 1. Steam temperature should not ordinarily be used for this duty, since it will follow changes in reactor coolant temperature.

Operating control characteristics of each plant must be analyzed before selecting the control system. No two plants are necessarily alike. In addition to regulating-rod controls there will be positioning controls for shim and safety rods, if different from the regulating rods. An important auxiliary control supervises the indexing and positioning of the fuel-element transfer equipment when unloading and recharging a reactor core. Nuclear plants incorporate operating and safety interlocks also for (1) reactor power (2) coolant temperature (3) coolant flow (4) neutron flux (5) neutron generation period.

Controls for the nuclear plant should all be centralized in one room or area, from the reactor to the outgoing feeder. This ought to give better coordination of equipment operation and improved safety. Such a control room would use instrumentation, such as ionization chambers, to measure neutrons and gamma rays, thermometers for reactor and coolant temperatures, quantity meters for heat and electrical power, flowmeters and pressure gages for the plant fluid cycles.

Transmitters will send flow and pressure signals from the radioactive cycles to the control room. Transmitting systems with double barriers give protection in carrying information from alkali liquid-metal cycles to the control room. Both mechanical and electromagnetic flowmeters can be used with Na and NaK. Conventional flowmetering can be used for other liquid metals, water and gas used as reactor coolant, fuel diluents or carriers.

Sheathed thermocouples, iron-constantin or chromel-alumel, may be used in radioactive systems. The sheathing and insulation must withstand radiation and chemical effects of the coolant.

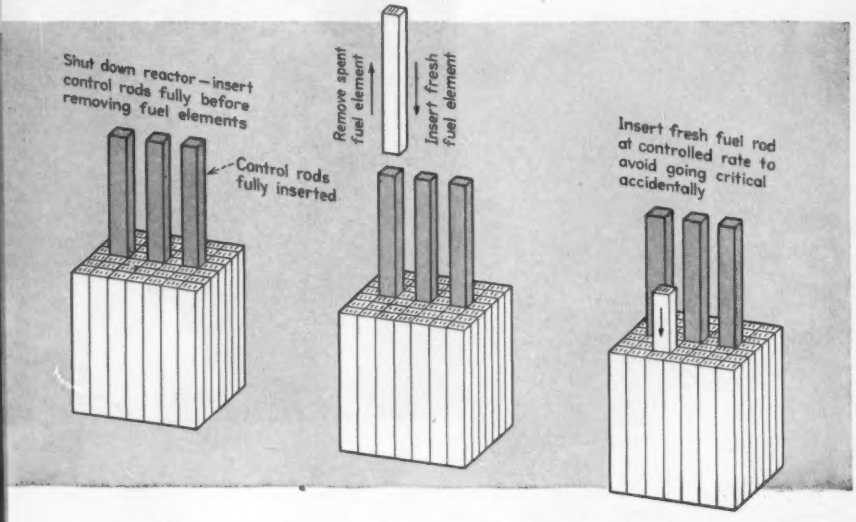
OPERATING SAFETY

Safe, simple and reliable methods must be set up for normal start-up and shutdown of a reactor as well as its refueling and emergency scram. The AEC relies on its Advisory Committee on Reactor Safeguards (ACRS) to review the design, operation, location and safety of all proposed reactors before granting approval for their erection. ACRS usually requires a "safeguards report" on each project, giving (1) over-all design parameters and characteristics (2) predicted operating characteristics (3) safety features (4) accident analysis study.

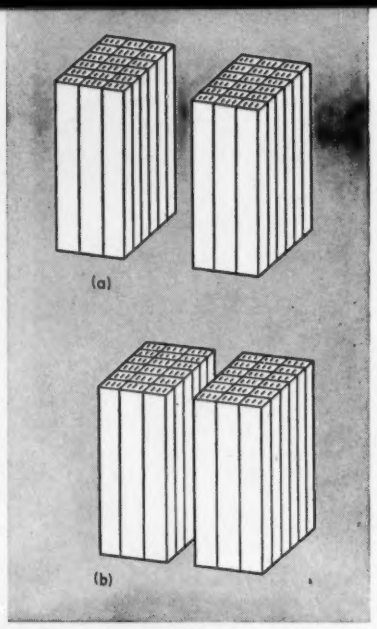
The latter study should cover accidents that could occur during initial reactor operation when it is (1) subcritical (2) running critical at zero power (3) running at low power (4) running under full load. Reactor accident conditions that should be considered include (1) various rates of insertion of reactivity into the core and (2) various totals of reactivity inserted. All such accidents, regardless of cause, should be tabulated. Behavior of reactor-plant power and temperatures with time should be figured for each type of accident. Next, the probability factor for each accident should be estimated.

Coolant system accidents affecting the reactor and the auxiliary circuits should also be tabulated.

Accident analyses have several pur-


Shut down reactor—insert control rods fully before removing fuel elements
Control rods fully inserted
Remove spent fuel element
Insert fresh fuel element
Insert fresh fuel rod at controlled rate to avoid going critical accidentally

2 Shifting fuel rods or removing spent rods and inserting fresh ones will be a critical operation in nuclear reactor cores; done while reactor is shut down



3 Moving two parts of critical assembly together allows studying of core

poses. They determine the effect and magnitude of reactor accidents and the need for radioactive containment. They estimate the possible extent of damage to the reactor plant and the subsequent repair and salvage of equipment. They provide data for thermal shock studies of the reactor and coolant systems. An accident may be assumed to involve a maximum of double-simultaneous failures. These may consist of (1) equipment failures (2) control and safety interlock failures (3) supervisory errors (4) natural hazards like high wind, flood or earthquake.

When first operating any reactor it may be necessary to proceed cautiously to satisfy the designers, operators and ACRS about the plant safety. In some cases "critical" and "safety" experiments may be made before building a reactor. A critical experiment uses a *critical assembly* consisting essentially of two parts or halves of an equivalent, or simulated, core assembly of a fuel material, Fig. 3. One part is fixed and the other movable. By slowly moving the two halves together a critical fissioning condition can be just established. Extremely short power periods may produce one or two kw. Such a test checks:

1. Theoretical calculations for the "critical mass" of the reactor.
2. Fuel subassemblies and enrichment for solid-fuel reactors and concentrations for liquid-fuel units.
3. Control-rod effectiveness.
4. Neutron flux distribution.
5. Fission product effects on fuel.

A "safety" test program determines (1) operating characteristics of the reactor, including start-up and shutdown (2) operating stability of reactor and auxiliary systems (3) transient characteristics of the reactor and auxiliaries. Many factors must be considered before deciding to carry out these tests on the actual plant reactor or on a simulated unit before building the plant.

During reactor starting and shutdown operations a source of neutron flux must be used for the monitoring equipment. Neutron source materials include: (1) polonium and beryllium combination giving an (α, n) nuclear reaction (2) an antimony-124 and beryllium combination giving the same reaction and (3) an irradiated fuel element from another reactor.

Refueling procedures require shutting down the reactor. With the safety control rods inserted in the reactor core, the spent-fuel elements can be removed and new fuel elements inserted in their place. Safety checks must be made continuously when inserting new fuel elements to guard against accidents, Fig. 2. An element containing too high an enrichment could initiate a chain reaction while being placed in the core. Inserting fuel elements at too fast a rate can be dangerous. Any action that would push or pull the control rods out of the core while changing fuel could be disastrous. For example, sudden starting of the coolant pumps might create a hydraulic pressure forcing the control rods out of the core and starting a growing chain reaction.

GENERAL PLANT FACILITIES

Reactor containment buildings may or may not be needed. This depends on the type of reactor, coolant and the probability of chemical-reaction and nuclear accidents. Rating of the reactor and its proximity to populous areas and the possibility of spreading radioactive material to such areas by wind or water after an accident must be considered. Gas volume, pressure and temperature, caused by the maximum possible accident, also control the size and need for containment.

Containment buildings may be eliminated where the plant stands in a remote area. Adequate cooling water must be available, however, and transmission distances must not impose too heavy an economic burden. Any reactor plant location must have the OK of ACRS. After more design and operating experience has been gained it may be possible to have less stringent safety requirements.

A nuclear plant will include conventional facilities like: turbine building, switchyard, railroad siding, machine shop, instrument shop, office space, locker rooms, cafeteria, etc. In addition, special facilities may be needed, such as: (1) fuel-element fabrication shop including inspection and testing labs which may have "hot" lab cells (2) fuel element processing apparatus (3) ra-

dioactive storage, clean-up, and waste-disposal equipment for fuel, gas and coolant (4) health-physics facilities for personnel (5) special facilities for shipping and storing radioactive materials (6) special plant security personnel.

EQUIPMENT INSPECTION

Nuclear equipment carefully designed must be translated into reality by both thorough specification and precise testing of components.

Non-destructive testing includes ultrasonic testing methods already covered in No. 13—Sept 1955. These methods used to date are arbitrary—a defect expressed in mils or percent material thickness over a minimum magnitude is cause for rejection. We still need a correlation between size and nature of the defect and its effect on the physical and mechanical properties of the material. When ultrasonic testing is not feasible a radiographic examination should be made.

Liquid penetrant tests should be used to locate surface cracks, checking or porosity in materials. These tests may also check surface condition of welds after grinding. Note, however, that liquid penetrant tests on welds could cause erroneous results in mass spectrometer tests because of plugging of extremely small fissures.

Marking materials and welds by stamping or etching should not be used because it could start stress corrosion at vulnerable points. Acids should not be used on type 304 stainless steel. Marring surfaces in contact with coolants may cause accelerated corrosion or mass transport, or both. This becomes especially important for materials in radioactive systems.

Leak-tightness tests of equipment and piping use mass spectrometer or pressure-holding methods. In the first method all surfaces should be thoroughly cleaned of water, oil and other contaminants. All openings must be sealed, except those needed for the test. The equipment is then evacuated to an absolute pressure less than 50 microns (1 micron = 0.001 mm Hg). While each welded joint is bathed with helium from a probe tube, the spectrometer equipment measures the leakage. The maximum leak should not be more than 0.005 micro cu ft per hr. General Electric and Consolidated Equipment Co make spectrometer apparatus for this type work.

In a pressure-hold test the equipment is also evacuated to less than 50 microns pressure. The pressure rise over 24 hr must then be less than a certain value, say 50 microns.

In a hood-type mass spectrometer leak test the equipment is placed inside a *Plio-Film* bag and then evacuated to less than 50 microns pressure. After filling the bag with helium at about 5 psig the total leakage rate is then measured. A permissible leakage rate might be about 0.01 micro cu ft per hr. If the actual leakage exceeds this, a helium probe test is used to spot the individual leaks. After repairing, the equipment must again be tested for leak tightness.

Cleaning all surfaces that contact the coolant must be done scrupulously. To do a thorough job use a detergent and degrease with an agent like trichlorethylene vapor. Surfaces should then be rinsed at least twice with distilled or demineralized water. As much moisture should be removed as possible. The equipment is then sealed air tight and pressurized with commercial dry nitrogen at about 5 psig for shipment and storage until finally installed.

EQUIPMENT EVALUATION

Thermal shock analyses should be carried out for all reactor plants, especially for plants with coolants varying through a high-temperature differential and with liquid-metal coolant systems with high film heat-transfer coefficients. Analyses should be made separately for reactor vessel, piping, heat exchangers, pumps and other apparatus. Data needed to carry out such a study include: (1) temperature at start of thermal transient (2) predicted maximum rate of temperature change (3) expected duration of transient (4) predicted temperature at end of transient and (5) probable number of times transient may happen during life of equipment.

Thermal stresses during steady-state operation should also be carefully analyzed and include any cyclic effects that may occur. Such an analysis also covers mechanical-design stress concentrations and fabrication stresses resulting from machining, welding, heat treating and the like.

Design codes prove valuable when preparing specifications for equipment of both fuel-fired and nuclear-fired power plants. For the latter, existing design codes must be carefully checked to choose the parts that are applicable. Usually more severe design parameters must be used to obtain equipment of maximum reliability for radioactive systems. Currently, work is under way to revise existing codes, or develop new ones, for designing piping, heat exchangers, vessels, etc, in nuclear power plants.

Equipment proposals. Analysis of manufacturing equipment proposals, based on specifications given, should be carried out the same way as for fuel-fired plant equipment. Important items to be evaluated include: (1) conformance of equipment proposed with overall and detailed requirements, and design and operating conditions given in the specification (2) cost (3) delivery (4) guarantee (5) evaluation and adjustments, if warranted, of effect of variations in efficiency, output, power consumption and other factors (6) adjustments for credits or debits caused by variations in erection costs of providing space, facilities and installation of equipment. Additional considerations should be given to actual operating experience on similar equipment, factors affecting maintenance, operating man power, etc.

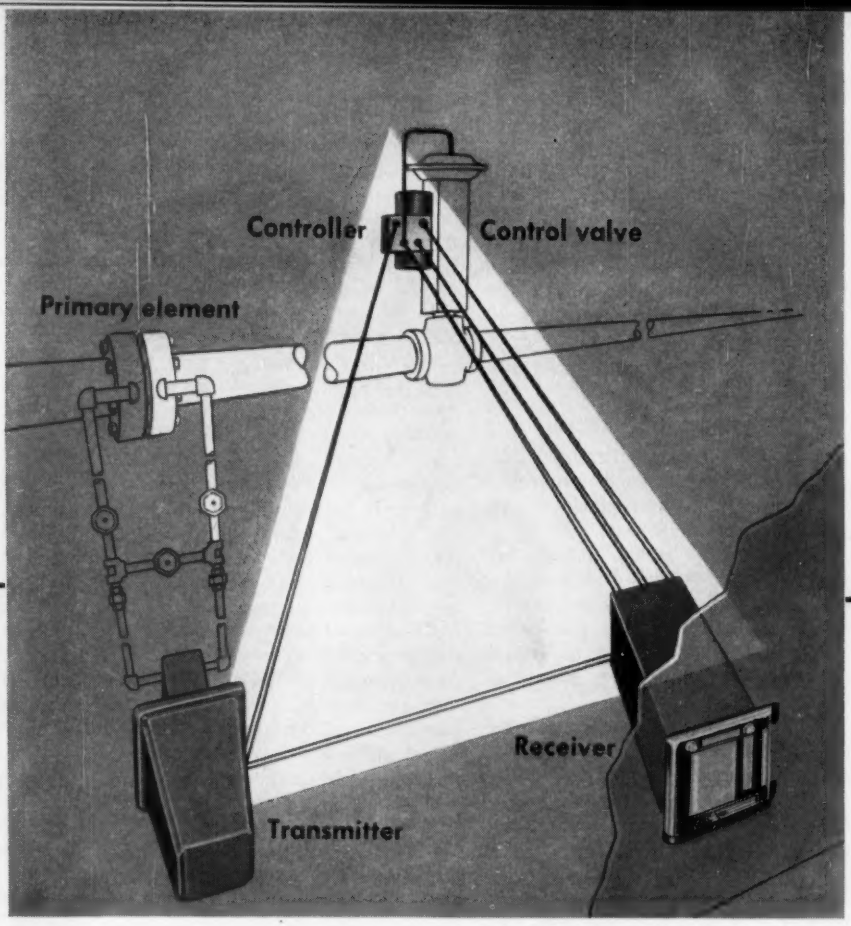
Expected equipment reliability should be an important consideration; basically, any equipment is only as reliable as the firm that made it. Reliability becomes paramount in a nuclear power plant. In a conventional fuel-fired power plant practically all equipment is accessible for inspection and maintenance as needed. In radioactive, nuclear equipment such accessibility is a moot point; it may be very difficult in most cases—sometimes it may be impossible. In any case it takes time for the radioactivity level to decay to the point where it is safe for personnel to inspect and repair. Every possible effort should be made to obtain equipment that incorporates simplicity of design and operation, and ruggedness of construction.

The next article will cover the designing of a graphite-moderated liquid-sodium-cooled nuclear power plant — in a forthcoming issue.

Reserve your copy now

Huge demand for reprints of *Nuclear Energy Study Course* has firmed up plans to make it available as a book. McGraw-Hill Book Company will publish—have it for sale by late 1956.

By M R SKROKOV
Field Engineer
Taylor Instrument Companies



Measuring, controlling fluid flow • First of a series

Primary flowmetering elements... how they work, where they're used

► KEEPING CLOSE TABS on fluid networks that feed much of today's power-service equipment is often a vital necessity. But, just as important, it's good business. Here's why:

When flows to and from equipment are accurately metered, controlled, costs can be figured exactly, peak operating efficiencies maintained. Even where flow control isn't needed, accurate metering can throw the spotlight on wasteful practices that may be cheating you out of added profits.

Tackling flowmetering and control problems calls for a basic understanding of equipment available, how it does the job, what types work best on specific jobs. In this and several follow-up articles, we're going to hit on key points that can spell the difference between good and poor flow-control systems. And since deciding between two systems often depends on stacking up their relative accuracies against relative costs, we'll also focus on these items. (*The series will not cover positive displacement meters. These units are intended mainly for totalizing or counting flow rather than for sensing flow rate.*)

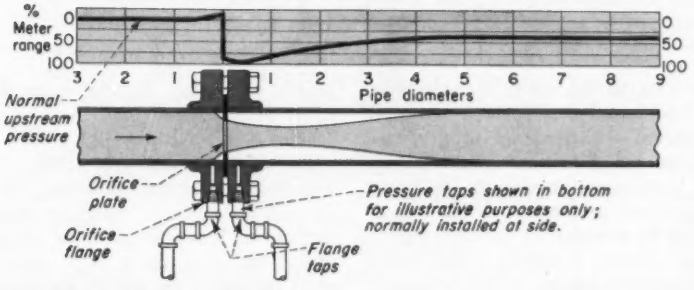
Basic physics tells us that pressure drop (pd) in a pipe or duct is directly related to flow rate: *Flow rate is proportional to square root of the pressure drop.* Instrument engineers put this principle to work in metering flow. They place a *primary element* in the flow path to produce a pd. Pd's direct relation to flow rate allows it to be recorded, indicated or controlled as a flow rate. But since the relation is only theoretical, instrument companies must correct for pipe roughness, turbulence. Correction factors are supplied with the metering system—usually in table, graph form or as a multiplying factor on meter door.

Diagram, above, shows a typical flow control circuit that includes: (1) primary element, and orifice plate in this case (2) flow transmitter (3) recording receiver (4) controller (5) control valve. Let's start with the primary element. It's mainly responsible for system's measuring accuracy.

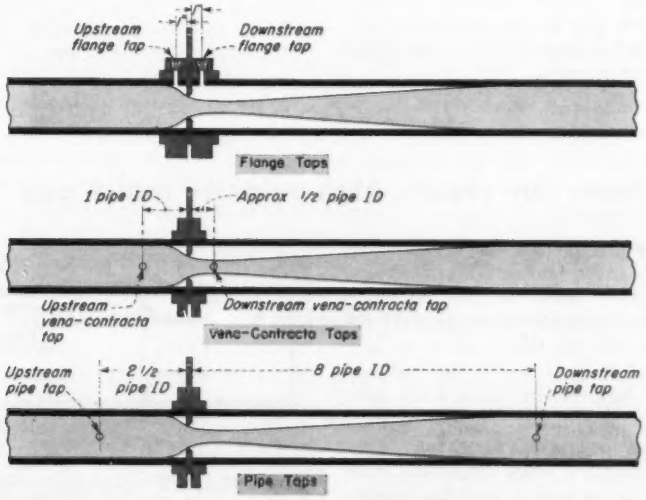
How primary flowmetering elements compare

Type	Pressure loss due to element in flow stream	Relative cost	General remarks
Orifice plate	High	Low	Most common primary element. Easy to maintain. Experimental data available for applying orifices to many flow conditions.
Flow nozzle	Medium	Medium	Commonly used for steam or high-velocity moist gas. Flow nozzle has, for a given throat diameter, about 60% greater capacity, than the thin-plate orifice.
Venturi tube	Low	High	Used where fluids contain suspended solids or where pd must be kept low. High cost in larger pipe sizes.
Pitot tube	Low	Low	Pd is too small for most industrial liquid-metering jobs. Used mainly for metering air in ducts. Tube can clog.
Pitot-venturi	Low	Medium	Magnifies actual pd. Used where pd must be kept low. Can be installed only in relatively large pipe (4 in. and up).
Elbow taps	Low	Low	Usually calibrated in field. Pd is the same as for ordinary elbow. When calibrated by manufacturer accuracy can be ± 1%.

1 Orifices . . . variety of designs, low cost make them most popular



PRESSURE DISTRIBUTION upstream and down of an orifice plate. Pressure drop at orifice is partly recovered several pipe-diameters downstream



PRESSURE TAPS can be hooked up to orifice plate in three different ways. Pipe taps, *bottom*, give flowmeter installation its greatest metering range

The orifice plate, most common of the primary elements, is nothing more than a steel plate with a small-bore hole. Full flow passes through the opening. Result is a measurable pressure drop across the plate accompanied by turbulence up and downstream.

To get predictable pd's, the hole must have a sharp 90-deg corner at its upstream face. Burrs or rounded corners cut down measuring accuracy. So it's important to choose a plate that stands up under all possible conditions.

Hole in plate is most often a concentric circular bore. But if you're selecting an orifice for gas-flow measurement where some condensate may be present or if job is liquid flow that may have suspended solids, your best bet may be the eccentric bore, drawing, top of next page. Third type is the segmental orifice. Its flow area is about the same as first two. But with area concentrated at pipe's bottom, sludges or high-solids-content liquids can pass through.

The quadrant orifice, drawing, top of next page, does away with a sharp edge, is used mainly where fluid's viscosity is high. In common with other types, its job is to boost fluid velocity, trim down line pressure, creating a pd. Drawing, above at left, shows how fluid pressure varies up and downstream of the orifice.

For pipe sizes to 10 in., plates are ⅛ in. thick. Larger lines need ¼-in. plates to limit possible deflection resulting from fluid's thrust. Pressure connections to orifice can be: (1) directly in orifice flanges—flange taps (2) just up

and downstream of the orifice plate—vena-contracta taps (3) several pipe-diameters up and downstream of the orifice plate—pipe taps.

Flange manufacturer drills flange taps one inch above and below faces of orifice plate. All you need do to use this setup is drill connecting pipe. And flanges can serve as a template,

Usual spot for vena-contracta taps is one pipe-diameter upstream and half pipe-diameter downstream, Drawing, bottom page 101, shows why they're called *vena-contracta* taps: Downstream tap lines up with point where flow reaches its minimum flow area—about a half pipe-diameter downstream,

Pipe taps, bottom, p 101, increase flowmeter capacity, Pressure connections are 2½ pipe-diameters above and 8 below the orifice plate. Graph above drawing, page 101, shows why pipe taps boost meter capacity, Tap senses downstream pressure at a point where fluid stream has recovered a substantial part of its initial pressure, So, for a particular flow, metered pd is less than for flange or vena-contracta taps. Result—max pd that meter can sense, corresponds to greater flow rate. Here's an example: Two-in. water line, fitted with an orifice plate has 50-in. wg maximum pd. Vena-contracta taps allow you to measure up to 58.5 gpm. Pipe taps boost this figure to 87 gpm—with the same meter differential.

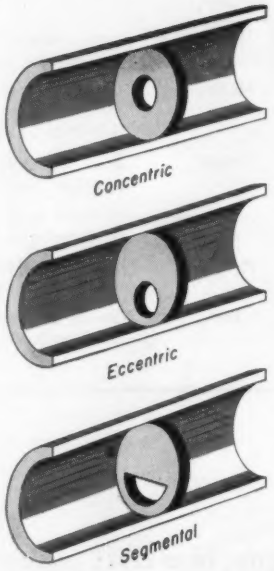
Orifice bores are limited to 0.70 of the pipe ID for lines to 3 in. and below. Above 3 in., maximum bore is 0.75 of pipe ID. Bigger orifice-plate openings disturb flow pattern, hurt metering reliability. Exception to the rule is vena-contracta taps. Maximum ratio for them is 0.80.

Orifice accuracy depends on many items. But only a few of these come under your control if you're a flowmeter user. Most important: Give full, reliable data to the meter manufacturer. He'll be in a better position to supply equipment that lives up to predicted performance. Be sure to tell him flowing temperature, maximum, minimum and normal pressures. It's his responsibility to produce an accurate orifice. Bore tolerance is usually within 0.05% of specified diameter, exceeding measuring sensitivity of any headtype flowmeter. Over-all readable accuracy is within one to two percent.

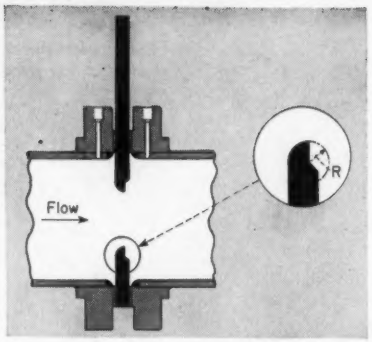
Offshoot of the orifice plate is the calibrated orifice element, drawing above. It's used for line sizes below 2 in., where orifice-bore sizing, pipe roughness present a problem. Getting better than 12% meter accuracy with regular orifices in such small lines is tough.

To calibrate this type orifice the manufacturer runs different flows through the element, works up correction curves based on expected and actual flows. You apply these data to chart records to get correct readings.

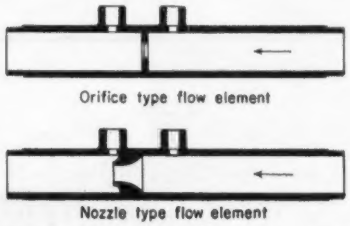
Installing calibrated orifice elements in new or existing meter lines is easy. Welding or threaded unions do the job. Calibrated nozzle elements, also shown above, are available, but aren't too common. Calibrated elements insure meter accuracy to 1% or less.



ORIFICE DESIGN can be concentric, eccentric, segmental, depending on use



QUADRANT ORIFICE does away with a sharp edge. It's used for viscous fluids



CALIBRATED ELEMENTS yield better accuracy in pipelines smaller than 2 in.

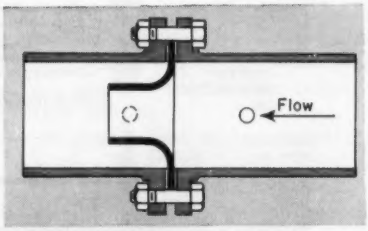
2 Flow nozzles . . . consider them for steam, high-velocity moist gas

Basically, a flow nozzle is nothing more than a short cylinder, flared at one end to form a curved entrance that guides fluid. Flow discharges from straight section (throat) in a straight jet. Pd, resulting from reduced flow area, is measured and correlated to flow rate.

Upstream pressure-tap connection is usually about one pipe-diameter ahead of the nozzle's entrance cone. Downstream tap is closed to end of the flow-nozzle throat, drawing at right.

Advantage of flow nozzle over orifice is its more constant discharge coefficient (correction factor to the theoretical relation between flow rate, fluid velocity and pd that we talked about on page 100). Engineers use it for metering steam, high-velocity moist gases—especially where metering range of a thin-plate orifice isn't big enough.

Investigators have compiled many more data on orifices than flow nozzles. Also, technical societies haven't agreed on standard nozzle designs.



FLOW NOZZLE'S advantages over the orifice plate are its more constant discharge coefficient, lower pressure loss

VENTURI TUBE uses a diverging section to recover pressure loss. It's relatively high-priced in larger pipe sizes

3 Venturi tubes . . . diverging section recovers most of the pressure loss

Cost is often the deciding factor in choosing between a venturi tube and primary elements we've just discussed. The venturi is priced higher than either the orifice or flow nozzle.

Drawing, top at right, shows how venturi tubes work. They momentarily increase fluid velocity, produce a pd in converging section. Diverging section, following throat, serves to recover almost all of pd, keeping pressure drop to a minimum.

Throat diameter is usually between one half and one fourth of inlet-pipe diameter. Included entrance-cone angle is about 21 degrees. Exit cone is five to seven degrees. Gradual exit angle assists in recovering pressure loss, reduces velocity.

High-pressure tap is just before converging section. Low-pressure tap is at throat. So diverging section has no effect on measured pressure drop. Its only job is to recover pressure loss. Thus, for minimum pd, the venturi is best primary element. Also, it's smart to consider venturis where more than 5% solid matter is in fluid. Reason: They have no abrupt cross-section changes—where solid matter can build up.

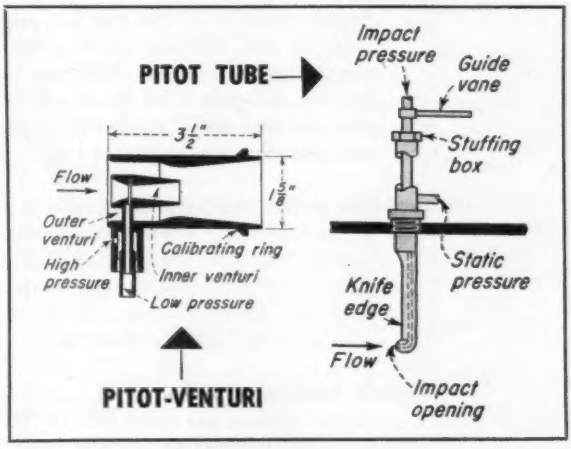
4 Pitot tubes . . . they're used for specialized metering jobs

The pitot tube is often put to work measuring flow where: (1) temporary installation will do the job (2) size of duct or pipe makes other methods impractical. Main objection to its use for continuously-operating industrial jobs is its sensitivity to dirt, other solids. Small quantities of dirt can clog the tube or build up enough layers to throw meter readings off.

Principle. Pitot tubes measure static, total head at a single point in the flow stream. Velocity head—the difference between static and total head—is proportional to flow rate. Common form of the primary element itself is nothing more than a simple impact tube inside a static tube, drawing at right.

To locate the pitot in a large duct or pipeline, place it in several predetermined positions across the flow area and record velocity head at each point. Final location should be close to flow stream's average-velocity point.

The pitot-venturi, drawing at right, combines two miniature venturi tubes, one within the other, on a pitot mast. Inner venturi, at throat of outer, yields much bigger pressure differences than the pitot tube alone. But actual pd in the flow stream is low. For air speeds over 1000 fpm, developed pressure difference is about ten times that possible with the pitot tube. Result: Relatively small air-flow changes can be sensed and recorded with good accuracy.



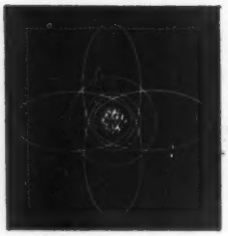
The close relation between flow and pressure difference in a pitot-venturi depends on accurately positioning a calibrating ring, drawing above. The element is used for liquid- and gas-flow measurement. But its size limits application to 4-in. lines and larger. Pitot-venturi comes already calibrated.

5 Elbow taps . . . centrifugal force produces the pressure difference

Centrifugal force acting on flowing fluid as it passes through an elbow is sometimes put to work by control engineers. The force causes a fluid-pressure difference between smaller and larger curved surfaces of a 90-degree elbow. And static pressure taps at these surfaces sense the pressure difference.

Since the element is just a commercial elbow, it's a low-cost method. And pd is no greater than you'll find in ordinary elbows because static-pressure taps don't interfere with flow area. You may want to consider them on jobs that can tolerate no extra pressure drop.

Possible drawback to elbow taps: their uncalibrated accuracy. Unless they're calibrated in the field, chances are you won't do better than $\pm$ 5% accuracy. Calibration by meter supplier can drop error to about 1%.



Nuclear notes

By B G A SKROTZKI, *Associate Editor*

Over 500 applications for access permits have been granted by the AEC. These were granted to industries, business firms and individuals to give them classified data on civilian uses of atomic energy. Most of these applicants are interested in the design, development, construction, component parts, instrumentation and auxiliary equipment of power reactors. Others show interest in making special materials like zirconium, carbon and alloys for reactors and in the chemical processing of spent-fuel elements and refining of uranium and thorium.

Costs of first core of Shippingport reactor will allow producing an electrical kwhr for about 52 mills (5.2c). This total operating cost builds up from 15 mills for fixed charges, 39 mills for fuel, 3 mills for operation, less 5-mill credit for chemical reprocessing. Second core will step up capacity from 60 to 90 mw and is expected to reduce total cost to 39 mills per kwhr. Third core will probably reduce costs to 15 mills per kwhr, according to Admiral H G Rickover.

Nuclear plant investments for six projected central stations have a wide range. Duquesne's Shippingport Plant, 236 mw, 585-psig-sat. steam—$630 per kw; Consumers Pub Power Dist, 75 mw, 800-psig 825-F steam—$320 per kw; Yankee Atomic Electric Co, 134 mw, 160-psia sat. steam—$230 per kw; Atomic Power Development Assoc, Detroit, 100 mw, 600-psia 730-F steam—$540 per kw; Nuclear Power Group, Chicago, 180 mw, 600-psia 480-F steam—$250 per kw; Consolidated Edison, N. Y., 250 mw, 420-psia 1000-F steam—$230 per kw.

Test-tube power reactors being built by Los Alamos Lab of AEC are of aqueous homogeneous type using a phosphate solution. This solution may be more stable under irradiation than a sulfate solution and can carry a high concentration of uranium fuel. Greater corrosiveness, though, leads to using gold cladding in reactor shell. One reactor uses forced cooling and the other natural convection. Heat-production ratings will be about 1300 and 2000 kw.

Organic moderator and coolant may hold much promise to lower cost of power reactors. Organic liquids can reach 600- to 700-F temperatures at atmospheric pressure without boiling. Diphenyl and terphenyl resist radiation damage and have good moderating characteristics. They can be handled by equipment built for Dowtherm.

Liquid-metal fuel reactor has uranium dissolved in liquid bismuth. The bismuth can be pumped through the reactor and heat exchanger or can be contained within the core. Graphite and low chrome steels can be used in reactor and worked at about 1400-F and atmospheric pressure. Breeding may be possible in a thorium blanket with U-233 as fuel. Low solubility of uranium in bismuth requires using high enrichment. Brookhaven National Lab is developing this unit.

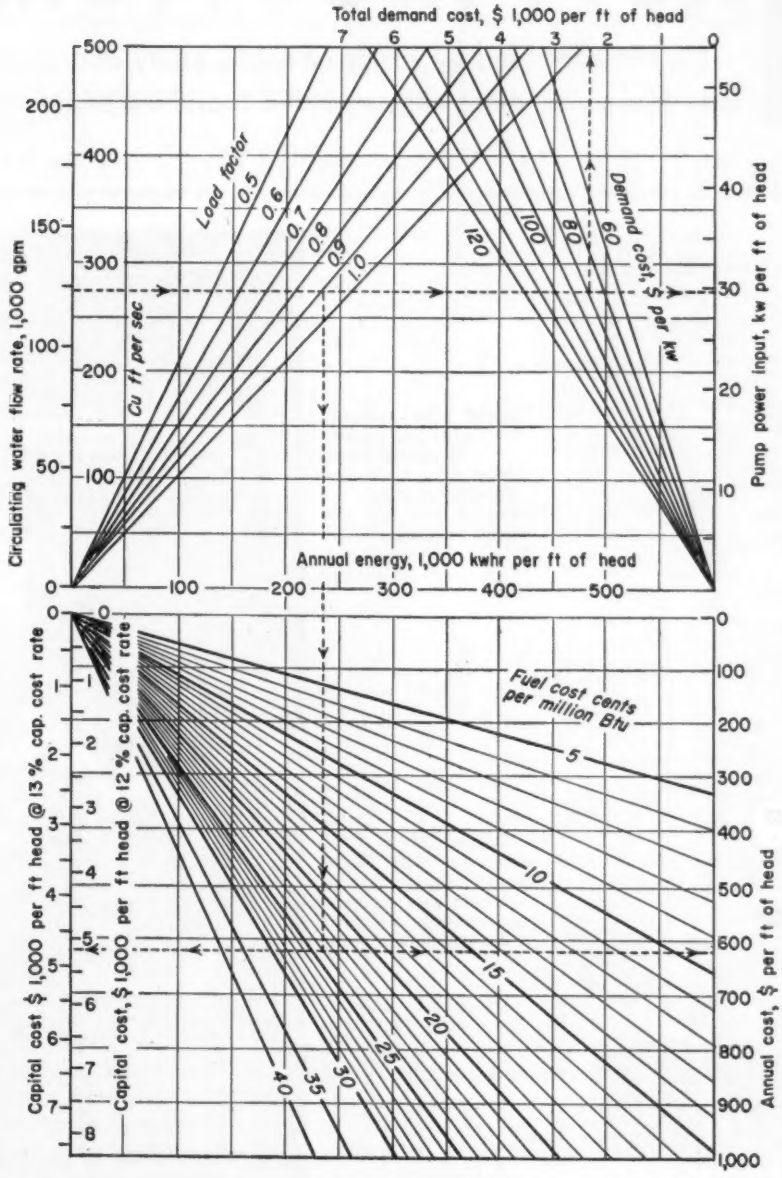
Reactor development takes about 5 to 7 years: Component development and testing, 1 to 3 years; engineering design, 1 year; construction, 2 to 3 years; testing and initial operation, ½ to 1 year; significant operation (1st core), 1 to 3 years.

"Burning" stone to make heat may be literally true in a nuclear sense in the distant future. Granite contains about 30 ppm of thorium and uranium. Fissioning of *all* the uranium and thorium in one pound of granite would produce about 80 times more heat than burning one pound of coal.

Power's DATA SHEET

No. 284

Cost of pumping water through one-foot head



► THIS CHART helps to figure both the annual and capitalized cost of pumping a given quantity of condenser circulating water through a one-foot head. You can quickly solve problems like: (1) finding change in cost of pumping for altering the cw system to reduce or increase the pumping head (2) figuring amount of construction expense justified to improve pumping head reduction.

How to use. To find annual and capitalized costs follow these steps:

1. Enter upper left scales with given water flow, gpm or cfs.
2. Move horizontally to right to intersect *load factor* line, ratio.
3. Move vertically downward to *fuel-cost* line, cents per million Btu.
4. Move right horizontally to find annual cost for one-foot head, dollars. Multiply by total head to find total annual cost in dollars.
5. Move left horizontally from *fuel cost* intersection (3) to find capital cost for either 12 or 13% capital-charge rate. Multiply by total head to find total capital cost. For other capital-charge rates, divide total annual cost by the rate.

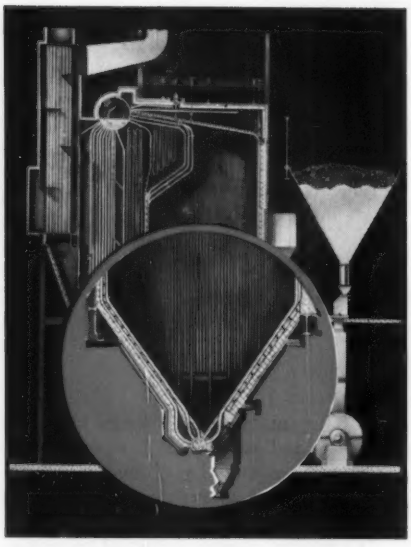
To find demand cost follow these steps:

1. From water-flow rate scale at upper left move horizontally to upper right scale to find kw pumping power for one-foot head. Multiply by total head to find total power demand, kw.
2. Move horizontally from power scale to intersect *demand cost per kw* line.
3. Move vertically upward to find demand cost, dollars, for one-foot head. Multiply by total head to find total demand cost.

Chart is based on: 78.3% over-all pump and motor efficiency, 8760 hr per year, 11,000 Btu per kwhr heat rate.

R T RICHARDS *New York, N. Y.*

© POWER



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Single Header

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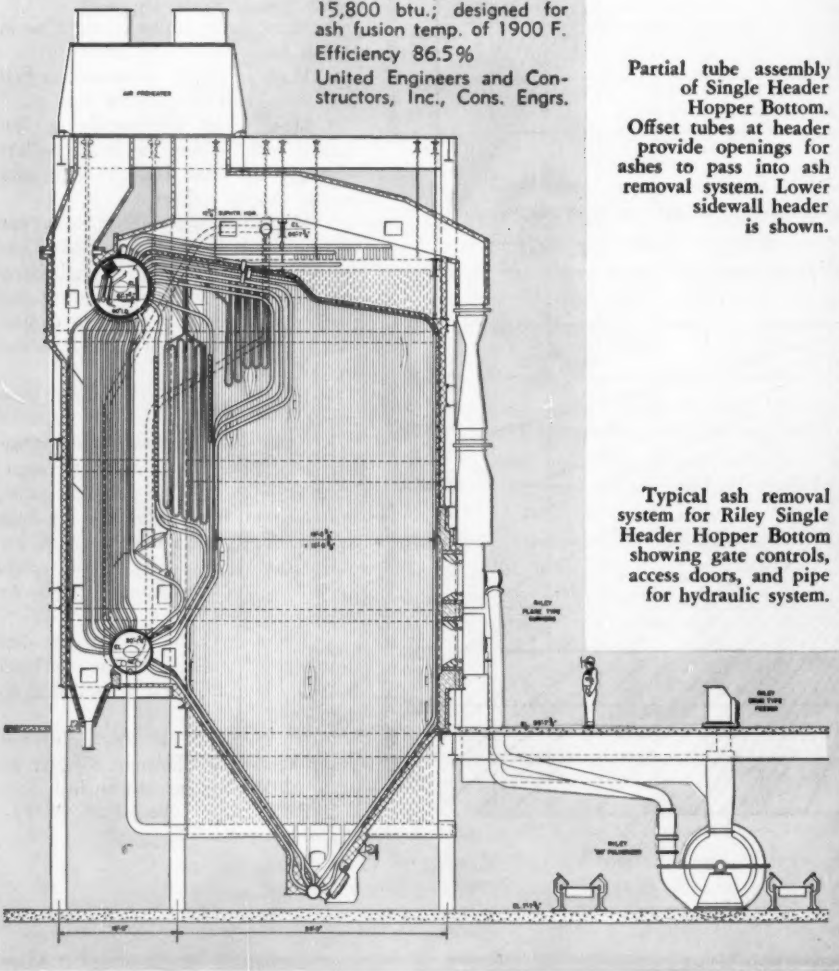
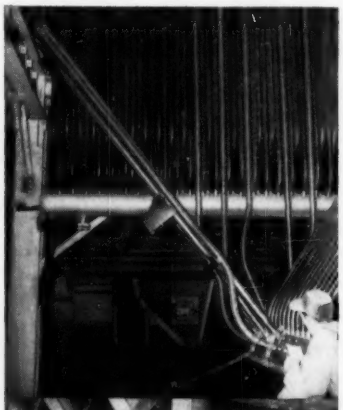
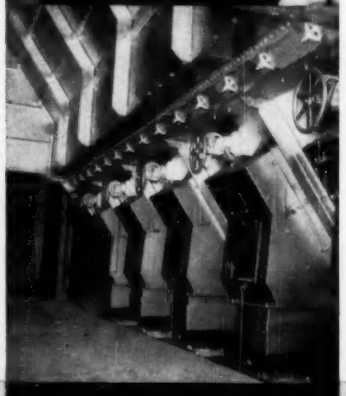
Capacity 150,000 lbs/hr. 835 F/1000 psig; furnace heat release per cu. ft. vol. 15,800 btu.; designed for ash fusion temp. of 1900 F.
Efficiency 86.5%
United Engineers and Constructors, Inc., Cons. Engrs.



Partial tube assembly of Single Header Hopper Bottom. Offset tubes at header provide openings for ashes to pass into ash removal system. Lower sidewall header is shown.

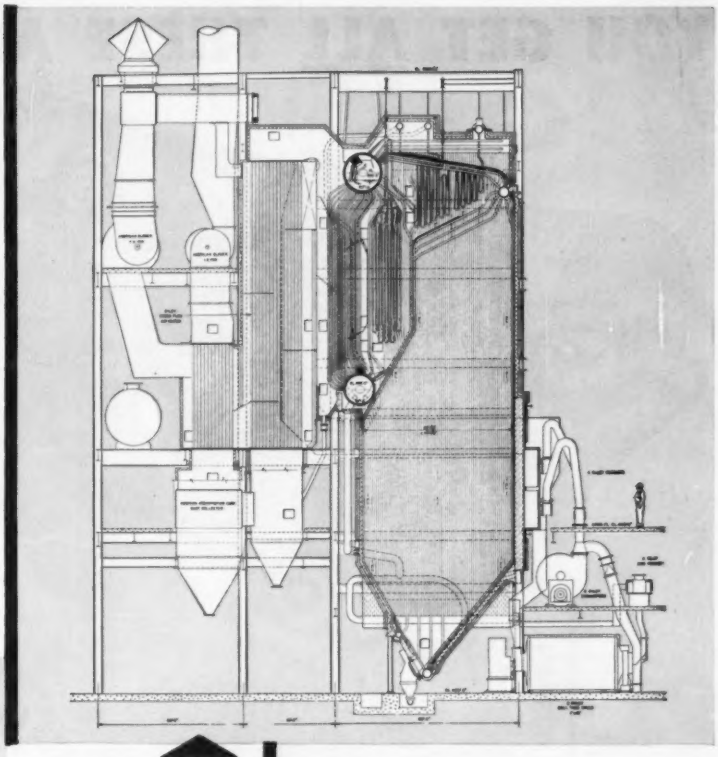


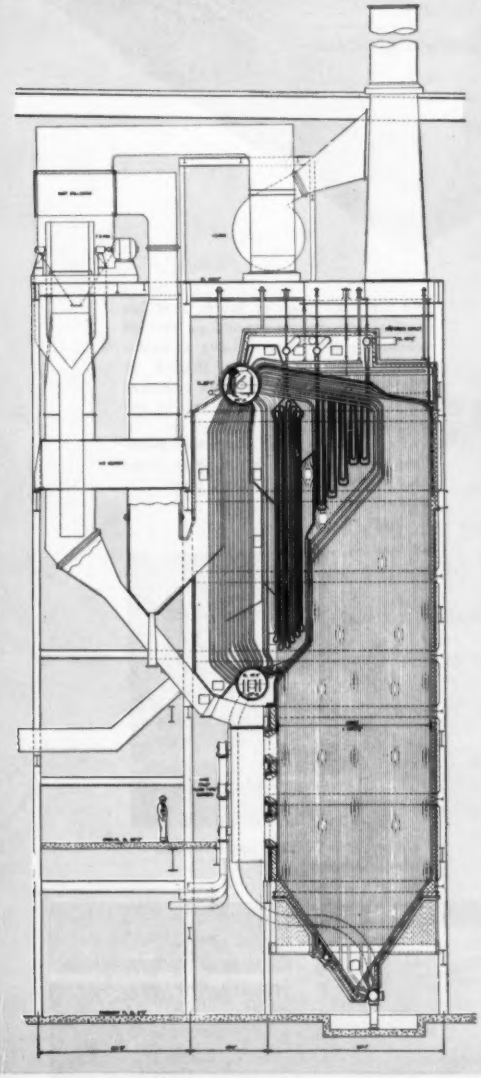
Typical ash removal system for Riley Single Header Hopper Bottom showing gate controls, access doors, and pipe for hydraulic system.



Your nearest Riley Representative will gladly furnish you with further details about Riley Single Header Hopper Bottom installations, or write to Riley Stoker Corporation, Dept. A, Worcester, Massachusetts.

- Successful with all types of high ash coals, even with ash fusion temperatures as low as 1900 F. No ash removal difficulties.
- Ideal for units firing a combination of coal, oil and/or natural gas, or, where coal may be used in the future.
- Integrated design eliminates the cost of separate hopper, and seals between unit and hopper with their maintenance.
- A convenient pneumatic or hydraulic ash removal system may be added.
- Reduces over-all building height . . . permits higher capacity unit in existing building.
- Adaptable to units of any capacity.





Dairyland Power Cooperative
Cassville, Wisconsin
Capacity 230,000 lbs/hr; 900 F/1000 psig; furnace heat release per cu. ft. vol.-19,300; designed for ash fusion temp. — 1980 F. Efficiency 86.0%
Vern E. Alden Co., Consulting Engineers.

South Carolina Public Service Authority
Moncks Corner, S. C.
Capacity 450,000 lbs/hr.; 900 F/925 psig; furnace heat release per cu. ft. vol.-17,000; designed for ash fusion temp. — 2150 F. Efficiency 87.7%
Ford, Bacon & Davis, Consulting Engineers.

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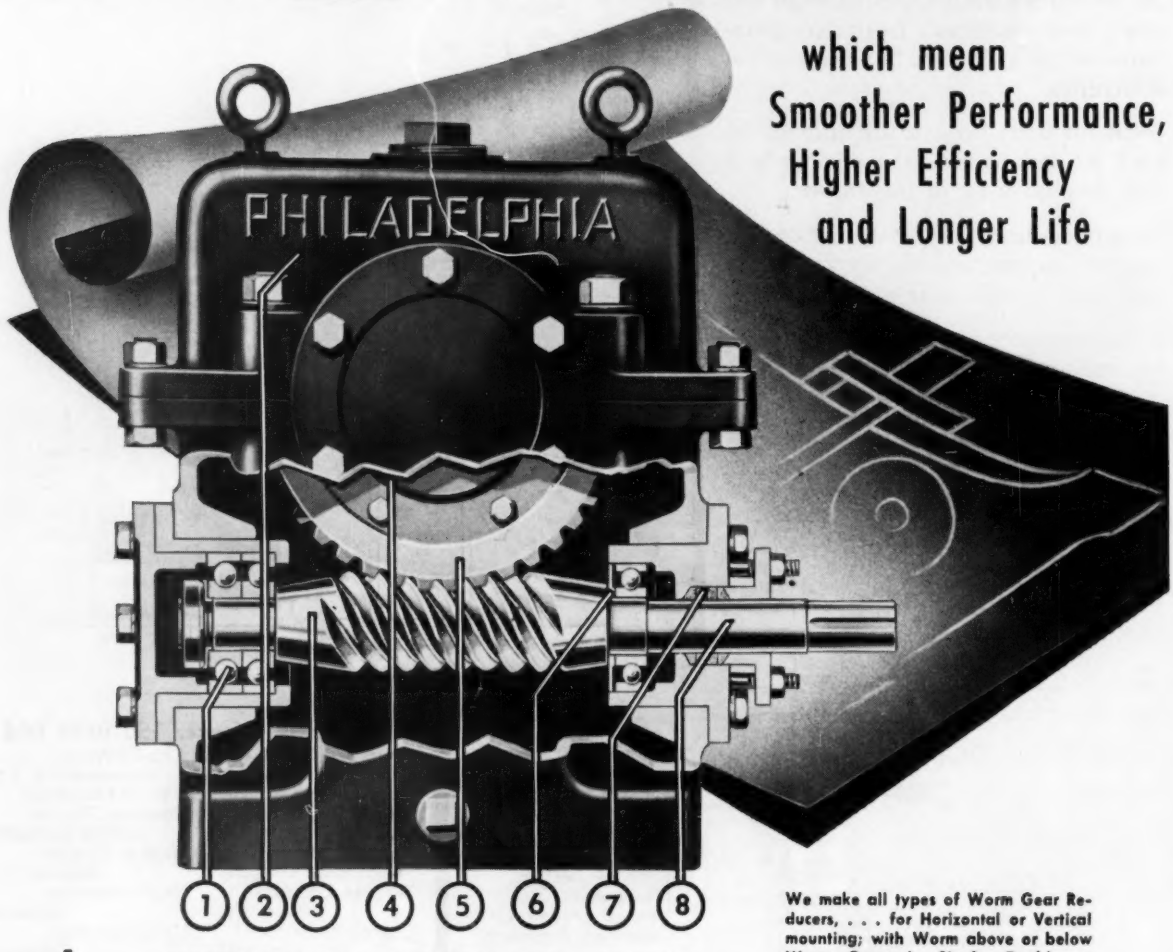


1____ **BEARINGS** throughout are of highest quality, calculated to take all loads and stresses in accordance with maximum ratings of units.

2____ **EXCEPTIONALLY RIGID HOUSING** of best grade cast iron . . . Strengthening ribs integral with design.

3____ **WORMS** made of SAE 3115 Steel with carburized and hardened threads. Shaft and threads smoothly ground after hardening.

4____ **GEAR SHAFT BEARINGS** run in an oil well that automatically fills with fresh oil when filled from top. Splash from the gear keeps the wells filled to the overflow point.

5____ **WORM GEAR** made from quality chill cast nickel bronze bolted to a semi-steel center. (Smaller sizes are solid bronze.)

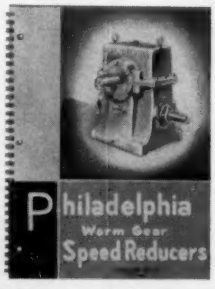
6____ **WORM AND WORM BEARINGS** run in oil bath. Baffle plates prevent flooding.

7____ **WORM SHAFT** equipped with stuffing box to prevent oil leakage.

8____ **SHAFTS** are premium quality. Always accurate, straight, concentric.

We make all types of Worm Gear Reducers, . . . for Horizontal or Vertical mounting; with Worm above or below Worm Gear; in Single, Double or Triple Reductions for medium or heavy duty service; any horsepower or reduction ratio.

Tell us your Speed Reduction problems, and a Philadelphia Sales Engineer will gladly call upon you, . . . without obligation.



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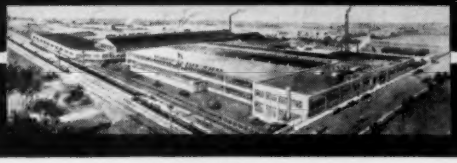

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PLANT OPERATION and MAINTENANCE
FEBRUARY 1956 **SECTION**

STEVE ELONKA
Associate Editor in Charge

Change gage glass...

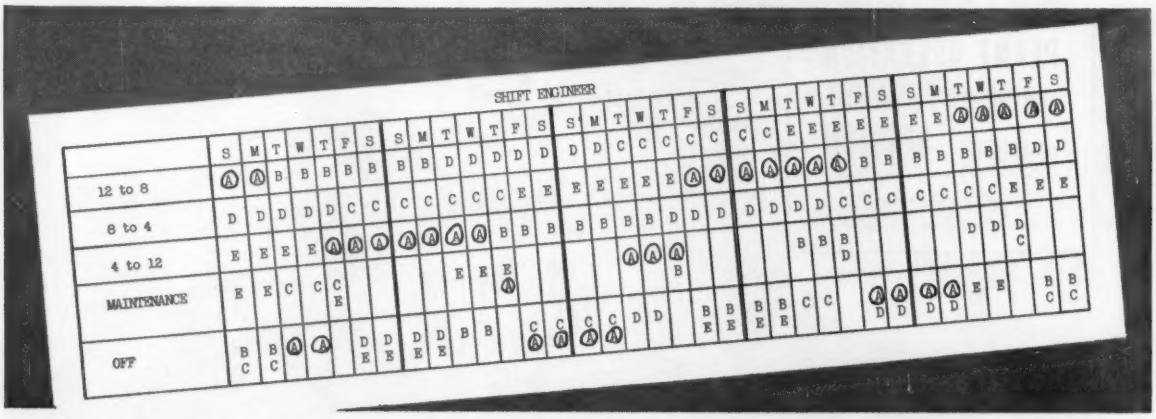
on Tuesday. Repair traps on Wednesday.
From maintenance to operating crew on Thursday.
Scheme breaks monotony of shift work—teaches men more about equipment.
Chief Engineer White's unique, popular maintenance-operating schedule system

► PLANNED MAINTENANCE is the key to smooth operation. Good schedules are worth their weight in man-hours. We proved it.

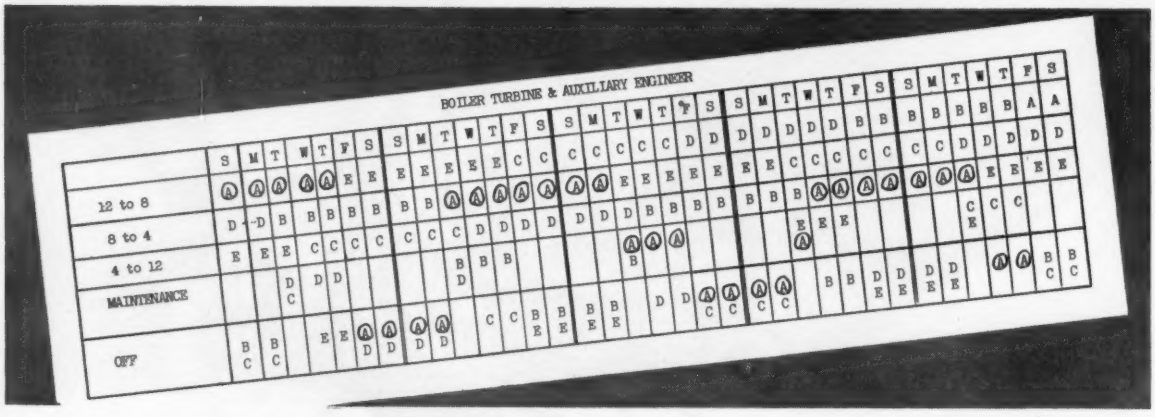
Our maintenance crew is set up differently from most plants. Regular crew is two men: maintenance foreman and plant electrician. Rest of crew is operating personnel when not on operating shifts.

Schedules, p 110, show how. Shift engineer A works shifts 12 to 8, then 4 to 12. In the second and third weeks he has four days on maintenance. Then back to shift work on the 8 to 4. Same is true of boiler turbine and auxiliary engineers, except rotation is reversed; maintenance days are in third, fourth weeks.

The men like the method. Breaks the monotony of shift work, and they learn more about the plant. Too—some men show special aptitudes. One is a good carpenter, another a good pipe fitter,



MONOTONY BROKEN for shift engineers. Schedule shows swing through days on maintenance during second and third weeks



MAINTENANCE DAYS for boiler-turbine and auxiliary engineers fall in third and fourth weeks; shift rotation is reversed

another, a good sheet-metal worker. We are happy to take advantage of these talents.

Maintenance crews are smallest on Fridays and Mondays. We use these days to draw up our weekly schedule. Maintenance foreman, electrician, results engineer and I go into a huddle. Operating schedule tells us what men we can have each day. We lay out what has to be done, when to do it, who gets each job. Larger jobs go to days we have greatest number of men. We discuss ways and means, man-hours, material needed. The all-important item of job safety rounds out the schedule. Posted in the shop, schedule shows each man when and where he works; gives him details of the job to be done.

Our coal crew is part of the team. Normally, two men take four hours a day to fill bunkers, clean and lubricate conveyor. Schedule shows what positions they play the rest of the day.

When job takes two or more men, we designate a lead man. If not maintenance supervisor or electrician, then top man of an operating shift. Schedule tells exactly what job is. A note may say to check with maintenance supervisor—maybe for detailed instructions or a word of caution about possible hazard.

Weekly routine jobs, not handled by regular auxiliary shifts, go to men on their maintenance days. Lubrication of turbine valve gear, coal scales, traveling screens, etc, get attention this way. No chance of being overlooked or forgotten. Also, jobs, like cleaning turbine-oil screens, clearing trash from heads of cooling-water heat exchanger, blowing out all fire hydrants, proceed smoothly from week to week. The men sign the schedule when jobs are done.

Our theory is to schedule shutdown and repair of equipment rather than wait for failure. Accordingly, we put shutdown of auxiliaries on our weekly maintenance schedules. It usually takes from September to April to check all auxiliaries. We allow a certain amount of time for possible emergency jobs.

Each year we open and inspect all equipment in the plant. During this shutdown, in addition to the major units, we get auxiliaries that can't be overhauled during plant operation, such as i-d and f-d fans, mills, etc.

This pays off. We often find things that later would have forced a shutdown.

For shutdown schedules, we again use a lead man for each crew: turbine, boiler, auxiliary, packing and miscellaneous. We discuss each job. Methods, material, time, safety. It's hard to set actual time. You can't be exact. But, proper planning gives surprisingly close estimates. We coordinate the jobs to complete all at the same time. We check to see how each is progressing. If some

Planned maintenance with accent on safety keeps men whistling, plant humming

NO LOST MOTION when preshutdown savvy lines up jobs, men, material, time →

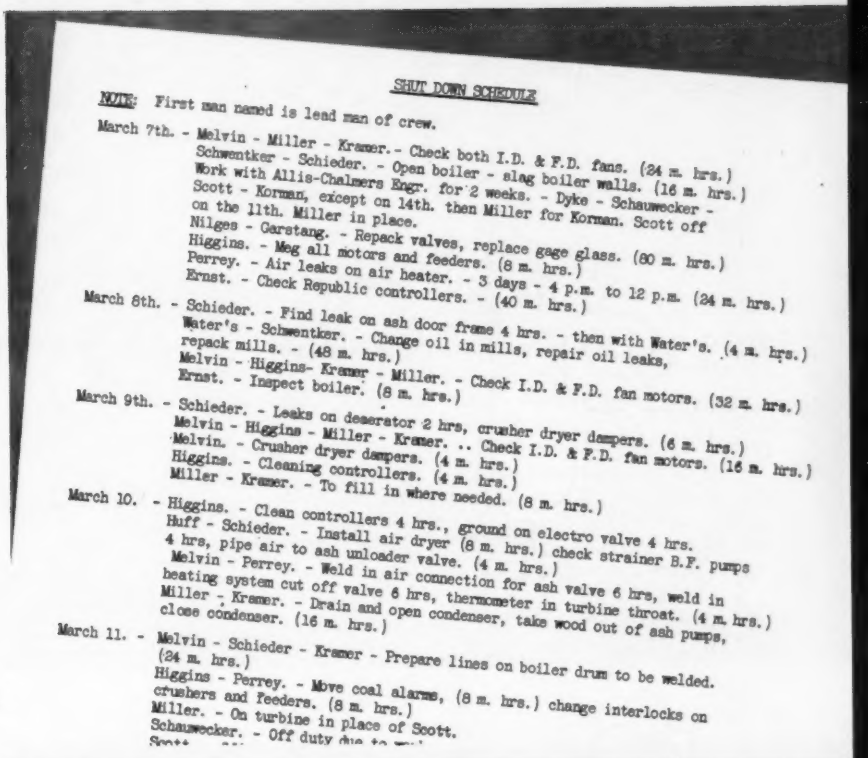
LUBRICATION can't be overlooked, overdone, with specific, detailed schedule →

crews are ahead of schedule, we shift men to crews who are behind or, if necessary, have a crew work overtime.

Such schedules make everybody's job easier. Our men are made to feel they are important to us. They know what is to be done, how it is to be done, amount of time the job is supposed to take—so they go ahead and do it. There is no confusion, no stream of men in the office asking what to do and how to do it. An occasional tour to check job progress is all that is needed. Takes a big load off the chief's shoulders.

Big dividend, of course, is long and reliable service from equipment. An ounce of prevention is worth a pound of cure. We know planning the how and when, through our schedules, really puts bounce in the ounce.

From a talk by K M White given by request before REA production officials. He is chief engineer of the REA Power Plant, Chamois, Missouri.



SHUT DOWN SCHEDULE

NOTE: First man named is lead man of crew.

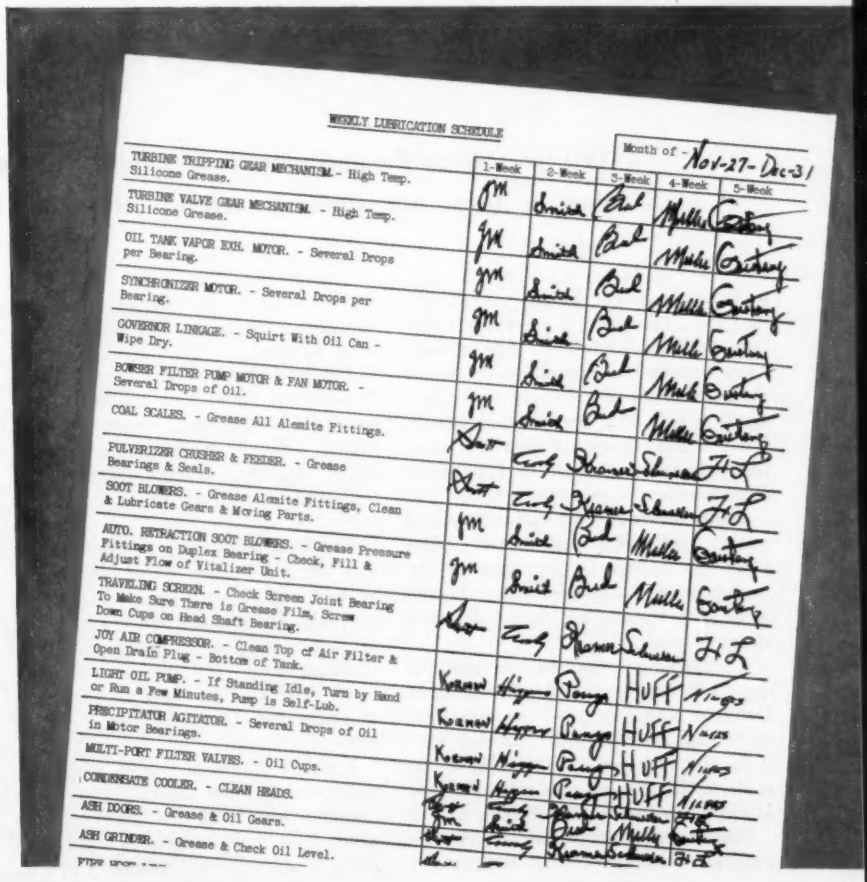
March 7th. - Melvin - Miller - Kramer. - Check both I.D. & F.D. fans. (24 m. hrs.)
Schwentker - Schieder. - Open boiler - slag boiler walls. (16 m. hrs.)
Work with Allis-Chalmers Engr. for 2 weeks. - Dyke - Schauwecker -
Scott - Korman, except on 14th. then Miller for Korman. Scott off
on the 11th. Miller in place.
Nilges - Garstang. - Repack valves, replace gage glass. (80 m. hrs.)
Higgins. - Meg all motors and feeders. (8 m. hrs.)
Perrey. - Air leaks on air heater. - 3 days - 4 p.m. to 12 p.m. (24 m. hrs.)
Ernst. - Check Republic controllers. - (40 m. hrs.)

March 8th. - Schieder. - Find leak on ash door frame 4 hrs. - then with Water's. (4 m. hrs.)
Water's - Schwentker. - Change oil in mills, repair oil leaks,
repack mills. - (48 m. hrs.)
Melvin - Higgins- Kramer - Miller. - Check I.D. & F.D. fan motors. (32 m. hrs.)
Ernst. - Inspect boiler. (8 m. hrs.)

March 9th. - Schieder. - Leaks on deserator 2 hrs, crusher dryer dampers. (6 m. hrs.)
Melvin - Higgins - Miller - Kramer. .. Check I.D. & F.D. fan motors. (16 m. hrs.)
Melvin. - Crusher dryer dampers. (4 m. hrs.)
Higgins. - Cleaning controllers. (4 m. hrs.)
Miller - Kramer. - To fill in where needed. (8 m. hrs.)

March 10. - Higgins. - Clean controllers 4 hrs., ground on electro valve 4 hrs.
Huff - Schieder. - Install air dryer (8 m. hrs.) check strainer B.F. pumps
4 hrs, pipe air to ash unloader valve. (4 m. hrs.)
Melvin - Perrey. - Weld in air connection for ash valve 6 hrs, weld in
heating system cut off valve 6 hrs, thermometer in turbine throat. (4 m. hrs.)
Miller - Kramer. - Drain and open condenser, take wood out of ash pumps,
close condenser. (16 m. hrs.)

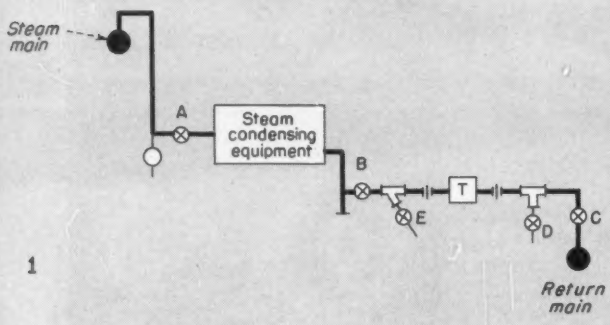
March 11. - Melvin - Schieder - Kramer - Prepare lines on boiler drum to be welded.
(24 m. hrs.)
Higgins - Perrey. - Move coal alarms, (8 m. hrs.) change interlocks on
crushers and feeders. (8 m. hrs.)
Miller. - On turbine in place of Scott.
Schauwecker. - Off duty due to



WEEKLY LUBRICATION SCHEDULE

Month of - Nov-27- Dec-31

	1-Week	2-Week	3-Week	4-Week	5-Week
TURBINE TRIPPING GEAR MECHANISM. - High Temp. Silicone Grease.					
TURBINE VALVE GEAR MECHANISM. - High Temp. Silicone Grease.					
OIL TANK VAPOR EXH. MOTOR. - Several Drops per Bearing.					
SYNCHRONIZER MOTOR. - Several Drops per Bearing.					
GOVERNOR LINKAGE. - Squirt With Oil Can - Wipe Dry.					
BOWSER FILTER PUMP MOTOR & FAN MOTOR. - Several Drops of Oil.					
COAL SCALES. - Grease All Alemite Fittings.					
PULVERIZER CRUSHER & FEEDER. - Grease Bearings & Seals.					
SOOT BLOWERS. - Grease Alemite Fittings, Clean & Lubricate Gears & Moving Parts.					
AUTO. RETRACTION SOOT BLOWERS. - Grease Pressure Fittings on Duplex Bearing - Check, Fill & Adjust Flow of Vitalizer Unit.					
TRAVELING SCREEN. - Check Screen Joint Bearing To Make Sure There is Grease Film, Screw Down Cups on Head Shaft Bearing.					
JOY AIR COMPRESSOR. - Clean Top of Air Filter & Open Drain Plug - Bottom of Tank.					
LIGHT OIL PUMP. - If Standing Idle, Turn by Hand or Run a Few Minutes, Pump is Self-Lub.					
PRECIPITATOR AGITATOR. - Several Drops of Oil in Motor Bearings.					
MULTI-PORT FILTER VALVES. - Oil Cups.					
CONDENSATE COOLER. - CLEAN HEADS.					
ASH DOORS. - Grease & Oil Gears.					
ASH GRINDER. - Grease & Check Oil Level.					



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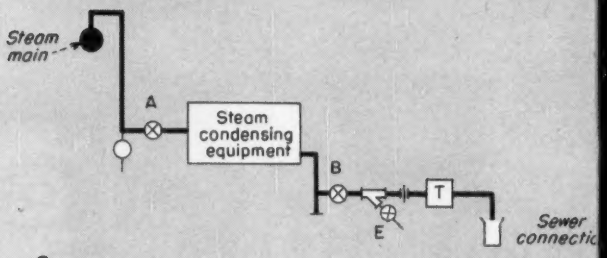

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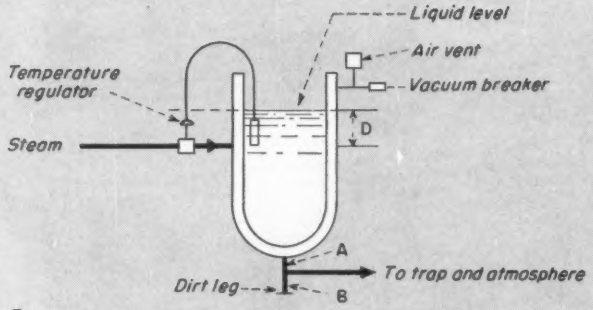

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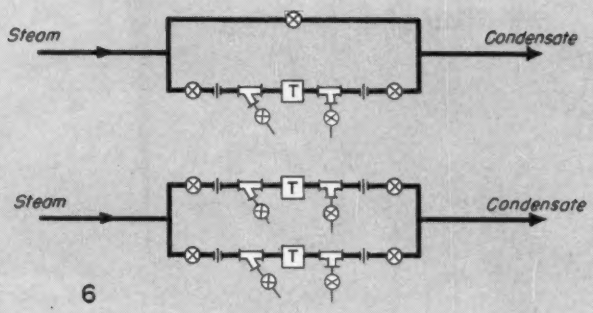


6

How routine maintenance keeps steam

You can step up the performance of steam-using equipment by seeing that its traps are working correctly. Here are tips on their care

► TRAP MANUFACTURERS recommend that you inspect and, if necessary, maintain your traps at least once a year. They believe this procedure helps you get best efficiency from your traps. In a small plant, trap servicing is simple. But if a plant has more than 500 traps, the project may revert to little more than breakdown maintenance.

Steam waste is too common in plants using breakdown maintenance. Too often the bypass is left open or the trap fails in the open position. Equipment may operate all right, but much steam is wasted.

Routine or preventive maintenance is the best answer to these conditions. Here's a plan that gives the maximum in annual maintenance. You can vary it to suit your needs. When you make spot checks of the traps, only portions of the program may be necessary.

Maintenance program. To get this program rolling, existing installations may need certain changes. Though conditions vary, Fig. 1, 2 and 3 cover most plants.

For equipment, you'll need: a surface-contact pyrometer, a listening rod or trap stethoscope, steam-pressure gages, colored marking tags, repair parts, assorted fittings, steam-fitting tools and an overhaul bench on a small truck.

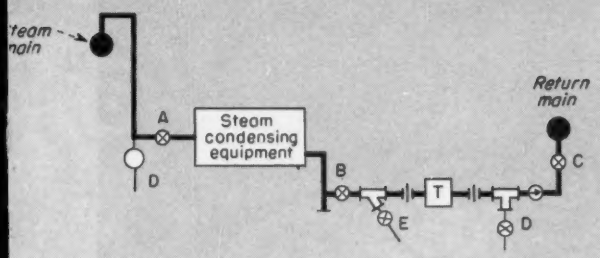
Checking traps. Use a sounding device like a listening rod or stethoscope to find out if trap opens and closes properly. Or you can do this visually, as shown in Fig. 1 and 3. Steps in checking are: (1) Close return-line block valve *C*, Fig. 1 and 3. (2) Open shut-off valve *D* from test tee. (3) Observe discharge.

Type of discharge varies with trap make. Get to know the discharge to be expected and learn the difference between live- and flash-steam discharge. Steps 1 and 2 are not necessary in Fig. 2 because the condensate is returning to an open drain or sewer.

Trap-size check. Process changes or poor selection may result in a trap being incorrectly sized. When watching the trap discharge, you may find an oversized trap remains closed for extended periods, while an undersized one stays open continuously.

Oversized traps may become steam-bound, requiring much time to condense this steam before a new load of condensate can be handled. This reduces production efficiency. With an undersized trap, condensate merely backs up in the equipment drained. This also reduces efficiency.

Have the manufacturer size your traps, or employ a consulting engineer. Then you'll know your equipment will be properly drained. They should also check the size of the return lines when new equipment is added to an old system in your plant.



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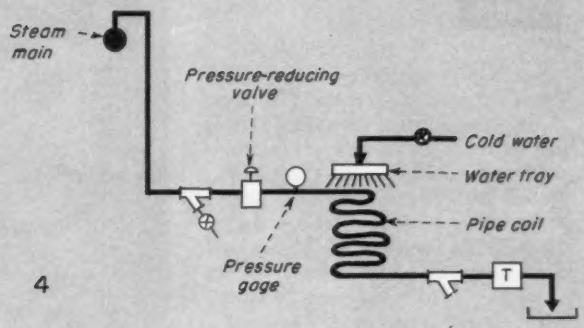


4

LEGEND

- Shutoff valve
- Strainer with blowdown valve
- Union
- Steam trap
- Tee with test valve
- Check valve
- Drip trap assembly as needed

Trap hookups for plant jobs—**1:** Condensate returned to an open flash tank with the return line below the trap. **2:** Condensate being returned to the atmosphere or an open sewer. **3:** Condensate being returned to an open flash tank with the condensate line above trap. **4:** Suggested test stand for traps that have been overhauled. **5:** Typical arrangement of the dirt leg, air vent and vacuum breaker for a heated kettle. **6:** Bypass arrangements for single and double traps. A typical sample tag for identifying plant traps is shown below.

traps fit and on the job

BY GLEN CHASE
The Yarnall-Waring Company

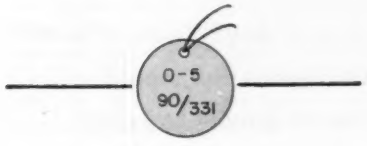
Trap efficiency. Most traps lose efficiency when not serviced periodically, even though they seem to work fine. For example, if batch cooking of a product takes 30 minutes with new equipment, the operator can turn out 14 batches in a 7-hr day. If the trap loses efficiency to the point where a batch takes five minutes longer, there is a loss of two batches per day. When a number of kettles suffer from this trouble, the loss in yearly production can be tremendous. And it all traces to trap efficiency.

Best time to find expected efficiency with a given trap is when it and the equipment it serves are new. To make this check: (1) Be sure the steam header is correctly dripped. (2) Record inlet-steam pressure to the equipment. (3) Measure steam pressure at trap inlet, valve *E*, Fig. 1. (4) Measure return-line pressure, valve *D*, Fig. 1.

Take temperature readings with the pyrometer, zeroing it in at valve *A*, Fig. 1. Set pyrometer to read the saturated-steam temperature corresponding to line pressure. Take the readings on a clean surface.

Take another pyrometer reading at the nipple ahead of the steam trap. It should equal or be close to the steam temperature corresponding to strainer blowoff pressure. Third reading should be taken downstream of the trap. It should equal or be close to the saturated-steam temperature at the condensate-return-line pressure. These readings must be interpreted in terms of the size and type of heat-transfer area. Best equipment efficiency is obtained only when the temperature ahead of it is equivalent to the temperature upstream of the trap.

Record and file the temperature readings. Attach a colored tag ahead of the trap, showing the year the trap was installed in new, serviced or overhauled condition. See diagram for other tag data. Temperature recording on the tag may be necessary only for critical production equipment. When your files show a number of failures on the same equipment type, or at the same location, analyze the traps to see if they suit their job.

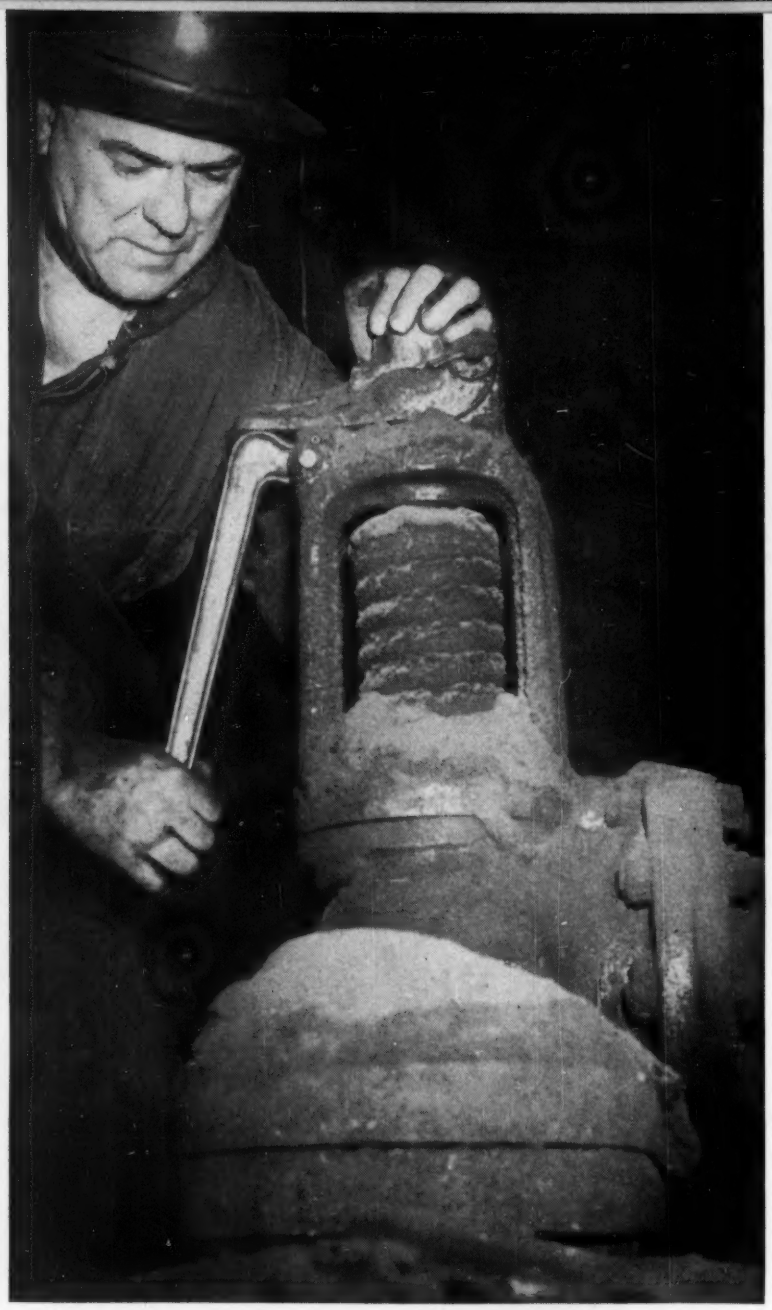


- Tag — Color to indicate year
- N — New trap
- S — Serviced trap
- O — Overhauled trap
- 5 — Month of N, S or O
- 90 — Steam pressure at trap
- 331 — Steam temperature at trap

Starting a program of this type takes work. But the yearly checks are much easier. Select a trap that is easy to service or overhaul while it is still in the pipe.

Trap overhaul. Use a shop test stand, Fig. 4. Overhaul the trap in the way the manufacturer recommends. Sometimes a thorough cleaning is enough

(*Continued on page* 215)



To POP . . . or not to POP?

Once a day? Once a month?
During the full moon?
Just on ground-hog day?
Here is the straight dope

► LAST YEAR, we printed a reader's question asking HOW and HOW OFTEN he should test his boiler safety valves.

We got a flock of answers. All agreed that safety valves must be tested. All agreed pretty much on the HOW. Big difference of opinion was the HOW OFTEN.

We think the matter is important. Since it turned out to be so controversial, we did some research. We talked with engineers: consultants, and chief engineers in large plants and small. With valve manufacturers and with boiler inspectors. We got a cross section of opinion. Here's what they say:

Boiler inspector. *John Todd, Chief Inspector, Hartford Steam Boiler Inspection and Insurance Company, New York:* Years ago, when weighted-lever safety valves were used, firemen moved weights, added weights, and even wedged timbers between the levers and the boiler-room roof. Held the valves shut. Easier to keep an even head of steam that way. But selfish chief engineers, thinking more of preserving their boilers than the feelings of the firemen, ordered daily testing of safety valves. This became established practice, more or less. With the advent of spring-loaded valves, daily testing continued from habit rather than from reason.

ASME Code recommends all boilers operating above 15 psi receive at least one annual internal and external inspection. Since it isn't practical to pop safety valves on high-pressure boilers, as in large utility and industrial plants, annual inspection should include removal of safety valves for complete overhaul and inspection.

Below 50 psi, pop valves once a month if plant is in poor condition. If in good shape, every six months is OK up to 600 psi. If you use the hand testing lever, have steam pressure at least 75% of safety-valve setting.

Chief engineer. *F M RePass, Consolidated Safety Valves:* Safety valves should be dismantled annually for cleaning and inspection. If plant operation leaves much dirt on valves, 6-month intervals are better. If plant is clean and valves in good condition, popping is not necessary oftener than every two months or so, up to about 650 psi. At lower pressures, increase the time between tests in proportion, but inspect often for clogged drains and dirt buildup in bodies.

Testing is a necessary evil, but should not be done oftener than absolutely necessary. Always a chance a piece of scale will be caught between disk and seat when the valve slams shut. Play it smart and have plenty of steam, at least 75% of set pressure, if you lift valves by hand. Best bet is to run pressure up to popping point. You know if the valves are working right—and you clear the seating surfaces. Another good angle: valves should be popped before a boiler outage. This checks need for repair or adjustment.

Valve manufacturer. *Crosby Steam Gage and Valve Company:* Popping safety valves every day may keep the log right on the ball, but it's unnecessary—and costly. If valves are clean, and this depends on good housekeeping, including feedwater treatment, don't induce valve leakage by frequent testing.

Tendency to leak involves two factors: (1) possibility of dirt or scale being trapped when valve closes (2) more important, the differential between setting and operating pressures. The nearer the operating pressure to setting pressure, the greater the possibility of potential leakage.

Setting up a testing schedule to cover all types of plants wouldn't work any better than a schedule for rainfall. Tailor testing to suit your own conditions. If you're in a chemical plant, chances are your valves take a beating from "gunk" in the atmosphere, and should be tested every two months or so. If you're in a spick-and-span plant, testing every six months should be enough. Best guide to a test schedule is experience. Try a set interval. Then a longer interval. So long as popping pressure remains constant, and valves show no inclination to stick, you're doing all right. Somewhere along the line you can establish a pattern. Since safety is most important, satisfy yourself that selected frequency meets this need.

Consulting engineer. *Wilson R Edwards:* Your testing schedule is dictated by your individual operating conditions. ASME *Suggested Rules for Care of Power Boilers* means just this by saying, "Test the valves in accordance with the instructions given for the particular plant."

It's no secret that frequent testing is an invitation to leakage or damage. Particularly if the valve setting is little higher than operating pressure. During normal operation, loading of the valve disk, being proportional to differential in operating pressure, is relatively small. The less valves open, the less chance of difficulty.

Safety valves, particularly those in dirty atmospheres, should be tested at intervals founded upon experience. In clean plants, at pressures up to 650 psi, testing at 6-month intervals is practical. Once a year, valves should be removed for inspection and testing. Plants in the high-pressure range, using complex controls, can't permit haphazard opening of safety valves. Such plants have rigid outage and inspection schedules. Prior to an outage, pressure is usually run up to popping point. During outage, valves are removed, inspected and overhauled.

In speaking of valve damage, we usually think of wiredrawing, or entrapment of foreign matter. However, we can't ignore the effect of thrust. Where discharge is perpendicular to stem axis, developed thrust can be high, depending on design and capacity. Mountings, particularly the flange bolts, are subjected to severe loading. Temperature cycling, plus shear stress could add up to bolt failure. That's another reason for less popping—and it points up the importance of inspection.

Testing tells we have protection against overpressure. But the act of testing is a form of valve maintenance and should be thought of as such. Proper function within design limits is worthy of more attention.

If slight leakage occurs, tendency too often is to increase spring compression just enough to stop leakage. Fact that this increases the setting is dismissed as negligible. Cause of leakage isn't eliminated. Though increase doesn't conflict with designed working pressure of boiler, or exceed spring-adjustment range, the end does not justify the means. Smart upkeep calls for valve overhaul, not fiddling with the spring.

More common disregard for designed function: continued use of higher-pressure springs following a permanent reduction of boiler operating pressure. ASME Code permits spring-adjustment range of 10% up to 250 psi; 5% on higher pressures. Example: reduction from 160 to 140 psi requires a change to a 140-psi spring, not merely reducing compression of the 160-psi spring to a 140-psi setting.

EDITOR'S NOTE: *In the above, consultant Edwards has added worthwhile comment. Basically, we're dealing with welfare of our safety valves.*

Popping safety valves

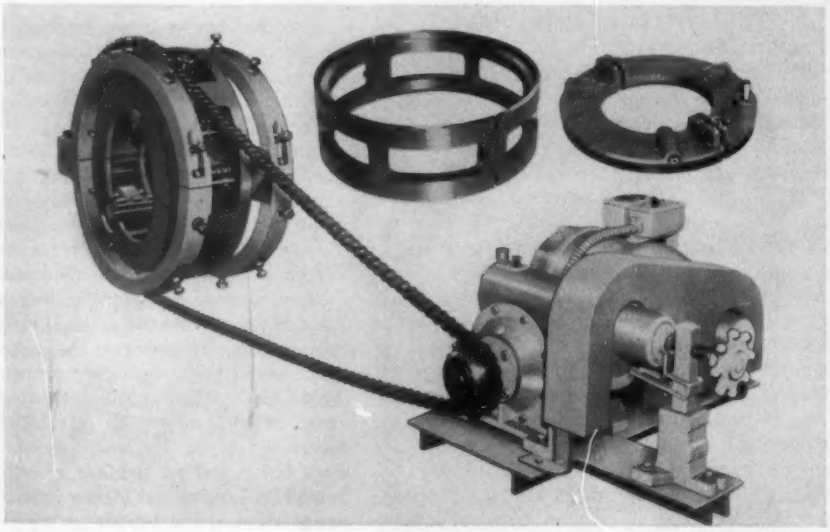
Here's the story . . . in a nutshell

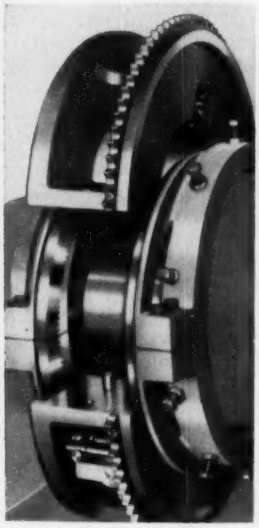
- **Frequent popping is harmful, costly**
- **Weekly testing rarely necessary; daily—never**
- **Dirty or clean plant, high or low pressure determine how often**
- **With hand lever, have steam pressure not less than 75% of valve setting**
- **Best way: Run pressure up to popping point**
- **Remove, test and inspect valves yearly**

OPERATORS' NOTEBOOK 94

Now, this 'inside-out' lathe

Here's your tool





COMPLETE MACHINE TOOL. With driving unit, tool fits on crank web of crankshaft. At right is shown cutting and honing head

REFINISHING crankpins without removing crankshaft from the engine has been a problem for years. While many diesel engines live to a ripe old age of useful service without ever needing crankpin refinishing, a pin will get scored from a hot bearing once in a while. Then problem is to machine it round and smooth.

Tool shown is what might be called an "inside-out" lathe. Instead of shaft to be machined turning against cutting and honing tools, as in a lathe, the cutting and honing tool turns around the shaft. Unit is designed to be positioned around the damaged crankpin, and hooked up to driving motor without removing crank from the engine. No doubt smart plant and power engineers will be using this tool for refinishing other parts than crankpins in their plants when some emergency comes up. Reason is that tool can be easily taken to a large journal, assembled around it and job done without tearing down machine. One such job should pay for cost of this handy tool.

Large machines and engines are usually completely dismantled and parts piled up on the floor, waiting to get shaft into the "big lathe," or "big grinder." Because even largest shops usually have one big tool to handle such emergency jobs, a simple scored pin or journal is often the bottleneck that ties up production.

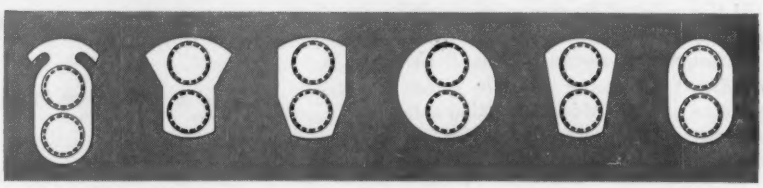
If the crankshaft is removed from engine for a complete overhaul anyway, just block crank up on floor and mount this inside-out lathe directly on crankshaft cheeks just as you would inside the crankcase.

Machine runs on two split adapters that bolt onto crank-cheeks. Machine itself is also built in halves, one half carrying the cutting bits and the other half carrying the honing stones. Accuracies of less than 0.001 in. in roundness and finishes of 32 microinches are common. Unit comes in five sizes at present, from crankpin diameters of 4 to 40 in.

There are 10 major parts: (1) cutting-head assembly (2) honing-head assembly (3) right-hand crankpin cheek adapter (4) left-hand crankpin cheek adapter (5) self-centering chuck for diametrically positioning crankpin adapters (6) spacer gage for checking parallelism of adapters (7) reduction drive and roller chain (8) motor and switches (9) special flexible inspection light, and (10) kit of spare cutters and hones. *Courtesy, Aero-Motive Mfg Co, Kalamazoo*

And here are some crank-web shapes that tool handles

Crank-web adapters for this tool must fit around webs of your engine's crank, so web shapes shown are important. The larger the crank throw, the larger the adapters must be to fit around them. Shapes shown can be handled by present refinishing tools made by this firm.



finishes crankshafts in place

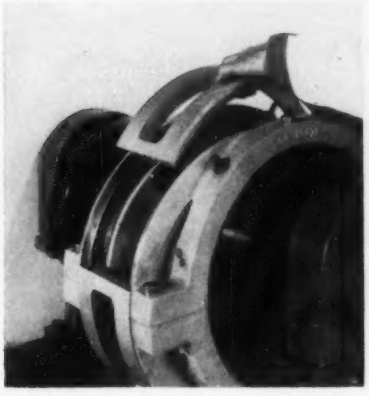
By **STEVE ELONKA**, *Associate Editor*

Set up tool in crankcase like this

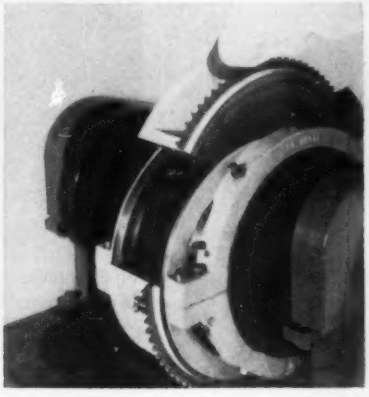
1 Clamp self-centering three-jaw chuck around crankpin needing remachining

2 Place left-hand adapter on self-centering chuck, run down to pin cheeks

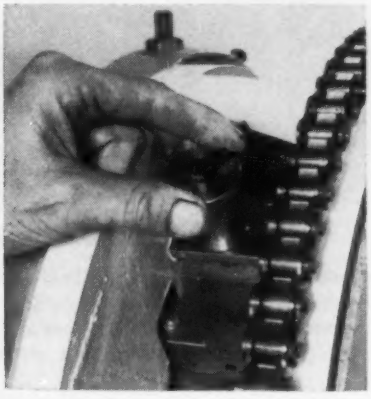
3 Now install right-hand adapter over crank web and bolt halves in place



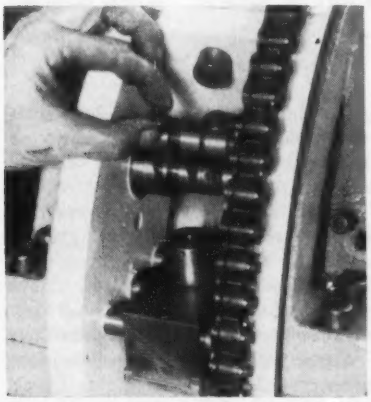
4 Position parallel gage that spaces the right- and left-hand adapters



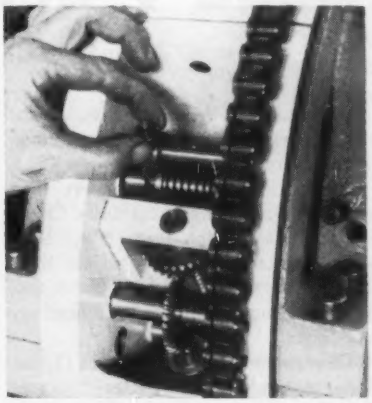
5 Position cutting and honing head on adapters. Comes in two sections



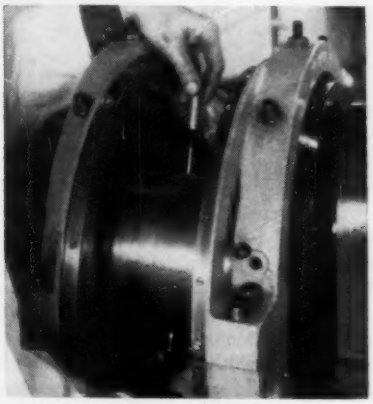
6 Adjust the micrometric downfeed of the cutting head and start the motor



7 Disengage the cutting head like this after your crankpin is cleaned up



8 Engage the honing head with this adjustment; then start the motor again



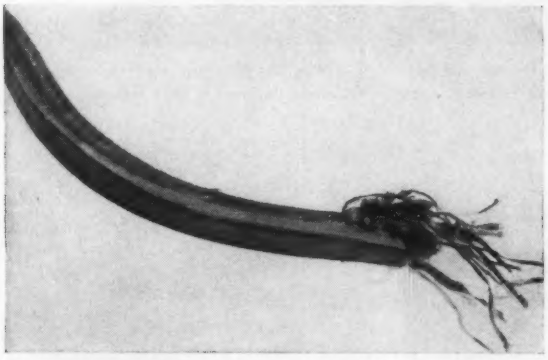
9 Remove the cutting and honing head. Pin is machined. Mike it for size

Oil deterioration

Rubber softened by oil; belt ruined. Often faulty splash guards—or none where needed—cause this softening. **To prevent** oil deterioration, use suitable splash guards. If you can't avoid splashing, install oil-resisting belts.

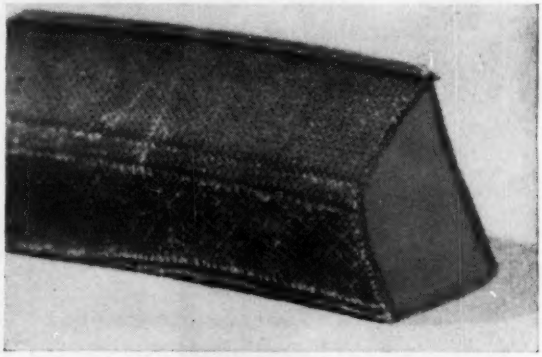
Cover-fabric rupture

Belt was pried over sheave when installing. Another rupture cause: wood or metal falls into the sheave grooves. **To prevent,** install belt right by moving motor up. Never pry the belt. A proper guard keeps foreign material out.



Ruptured belt

Cords broke in grommet or plies—because belt twisted in sheave groove, or rocks, tools, etc, fell into sheave. **To prevent,** check for proper tension. Loose belts may twist. Keep foreign material out of the sheave grooves.



Worn belt sides

Misalignment often causes wear on one side only. Grit or dirt and normal wear are other causes of worn sides. **To prevent,** align the sheaves, checking with straightedge or cord. Keep belts clean. Replace when required.

Nine dead V belts tell their

► PICTURES ABOVE from B F Goodrich's new bulletin, *Care and Maintenance of Industrial V Belts,* give your maintenance men a fast index to nine of the common causes of V-belt mortality. Use them to check specific causes of wear on your own drives, then follow suggestions below to get longer belt life.

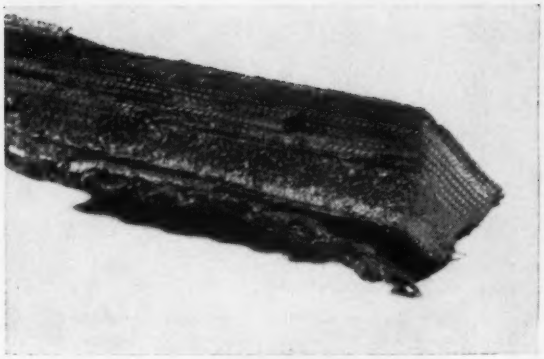
First: Engineer the drive to provide just the right number of belts for the work. Underbelting causes overloading, premature failure. Too many belts waste money, space, and make it difficult to keep proper operating tension. Check manufacturer's recommendations for proper sheave size, center distance, number of belts, efficient speed.

Second: Where there is more than one belt, match lengths carefully. Check symbols stamped on each. Short belts require extra tension to adjust their length with the longer ones. Extra tension puts more load on both bearings and belts.

Closest matching is required: (1) on V-flat drives (2) with center distances long for the speed ratio and cross section (3) with belts overloaded (4) with pulsating, uneven or vibrating loads (5) with severe conditions, indicated by past experience (6) in vertical drives.

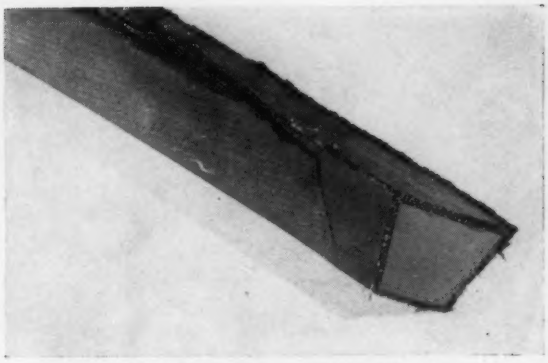
Third: Install carefully. Check that sheaves are properly aligned, grooves clean and free from foreign material. Don't pry belts over sheaves. Move motor up during installation, move back when belts have been put in place.

Fourth: Maintain proper tension, neither too loose nor too tight. Check with "slap test." Belts with proper tension feel springy and alive if slapped.



Slip burn

Belt was too loose; it didn't move and friction against sheave burned rubber. It finally grabbed, then snapped. **To prevent,** check for proper tension. If OK, review the drive for overloading, and redesign to fit load increase.

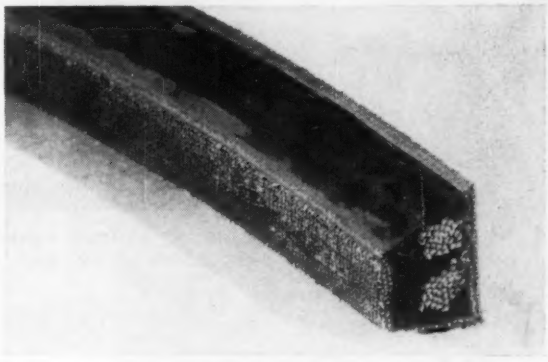


Ply separation

Sheave was too small; belt split along the pitch line because the severe flexing was too much for it to take. **To prevent,** check drive design, install a larger sheave as required. Don't go below suggested minimum diameter.

Snub break

Crack-the-whip snapped the belt suddenly, caused clean break. Wear on cover also indicated belt was slipping. **To prevent,** keep belts taut so they grip around the full arc of contact with the sheave. Check for proper tension.



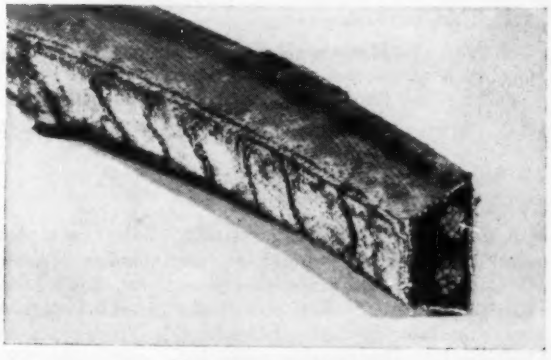
Abrasion

Sidewalls wore away because of foreign material and rust in the sheaves. Then belt dropped to bottom of the groove. **To prevent,** protect with dust guards. Check tension often, keep belts taut. They wear quickly if they slip.

tales of woe

Fifth: Keep clean, free of oil and protected from sunlight as much as possible. If you cannot protect from oil, use special oil-resisting belts. If surroundings are dirty, use solid shrouds. Check tension frequently. Abrasion wears belts quicker when they slip in the grooves. Also check sheave wear.

Sixth: Store in a cool, clean, dry atmosphere. Keep away from sun and heat. Don't place in bins for long periods, or hang on small pegs or nails. Use oldest belts first to keep fresh stock. Band matched sets of belts together.



Base cracking

Severe back-bend idlers cause this. So does improper storage or operating in an excessive ambient temperature. **To prevent,** add an additional 0.2 service factor in figuring drive with back-bend idler. Avoid temp over 150 F.

1 Two pipefitters carry two 20-ft lengths of Tenite butyrate plastic pipe to the ditch where it will be run. Each of the 3-in.-ID pipes weighs about 23 lb and is easily handled by two men. The pipe has extremely high corrosion resistance

Plastic pipe—your newest answer to handling corrosive plant liquids

New and proven piping materials cut installation time in half. Here's how a large utility uses butyrate plastic to handle corrosive well water

► A NUMBER of materials are used to make plastic pipe, depending on the properties desired for the finished pipe. That shown here is Tenite butyrate plastic, marketed by Eastman Chemical Products, Inc. The common name for pipe made of this plastic is cellulose acetate butyrate.

Pipe use. At the Wilmington, N.C. plant of the Carolina Power and Light Co, corrosive water was to be delivered a distance of about one quarter of a mile to the plant. After considering a number of materials, butyrate plastic was chosen because its corrosion resistance is so high.

Each 20-ft length of 3-in.-ID pipe weighs about 23 lb. Two lengths are easily carried by two men, Fig. 1. They are shown distributing the pipe alongside the ditch in which it will run.

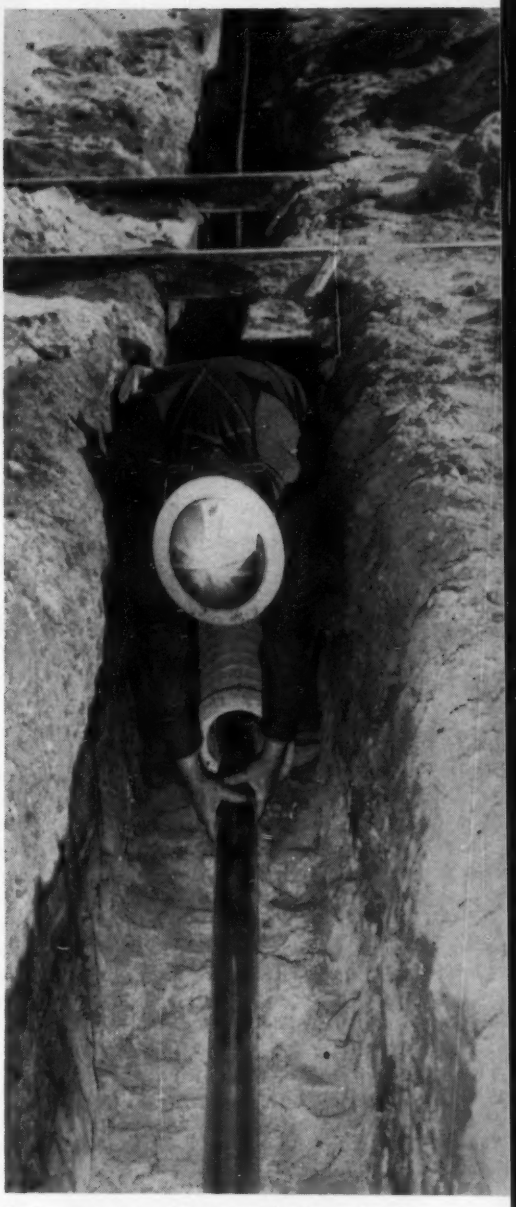
Joining pipe. Before the last piece of pipe can be joined to the line it serves, it is often necessary to cut it to the proper length. Here an ordinary handsaw is usually satisfactory, Fig. 2. Be sure to cut the pipe end squarely, so you can make a good connection.

With the pipe ready to be moved into place, each length can be joined to the next one in the run. Solvent cement, Fig. 3, is applied to the pipe and slip-sleeve couplings to make welded joints. The pipe is joined in a continuous length before being lowered into the ditch. Pipe shown here was installed in

2 An ordinary handsaw is used by the pipefitters to cut the last piece of pipe to the right length for the connection to be made

3 Solvent cement is applied here to the butyrate plastic pipe and to the slip-sleeve couplings to make the pipe joints leakproof

4 After the entire run of pipe has been joined by the solvent it is moved to the edge of the ditch, ready for lowering in place



5 To protect the pipe from shocks under this railroad track, it is enclosed in a conduit

half the time it would take to install a metal line.

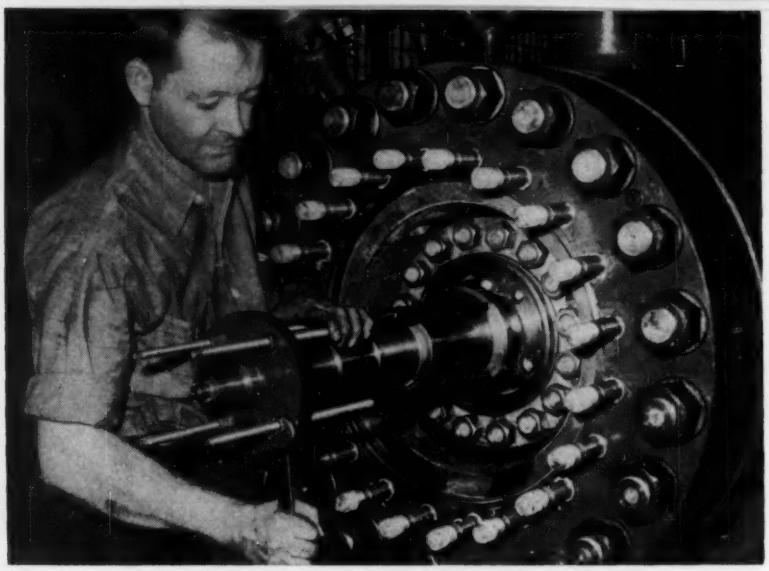
With the pipe joined in a single length, it is pushed to the edge of the ditch before being lowered, Fig. 4. When in place the line will deliver corrosive water from the plant well to the decarbonization tanks. This water will ultimately be used for all facilities in the plant, which is the largest in the Carolina Power and Light Company power system.

Shock loads, if extremely heavy, can damage plastic pipe. So where the line passes under railroad tracks, Fig. 5, a reinforced-concrete conduit protects the plastic pipe. The conduit was placed in the ditch and the plastic pipe run through it.

Once the pipe is in position and found satisfactory, it is ready to be covered with backfill. Correctly installed plastic pipe gives years of troublefree service, and has a good service record.

Construction of this pipeline was under the supervision of Ebasco Services, Inc. Grinnell Corporation supplied the pipe, which was extruded by Busada Manufacturing Co. While short pieces of plastic pipe can often be installed without a detailed engineering analysis, it is best to have long runs designed and installed by experienced piping contractors. Then you'll be certain of satisfactory results throughout the life of the pipe in your plant service.

By **IGOR KARASSIK**, *Manager Multistage Pump Section, and*
T W EDWARDS, *Application Engr*
Worthington Corporation



1 Split-ring shaft-sleeve puller can be a big help and timesaver. If sleeve is rusted to shaft, use a hammer to expand or crack sleeve. Be careful of shaft

Use periodic maintenance to step up

► BY FOLLOWING the steps given in an earlier article (POWER, May '55, p 86) you can eliminate complete annual inspection of barrel-type feed pumps if a regular inspection program is followed throughout the year. This program is based on daily, semiannual and annual checks.

Daily checks. Use a log, Fig. 2, to record daily such facts as capacity, pressure, temperature of water, motor-current input, bearing temperatures and similar information. Any fall in performance will quickly be shown by these readings. Then a more thorough check can be made. Because irregularities in pump operation indicate trouble maintenance men should report them at once. A marked change in the sound of the pump, an increase in its vibration, a sudden change in bearing temperatures are examples of irregularities.

Check pump stuffing boxes every hour. Leakage from packed boxes should be a large enough quantity to lubricate and cool the packing. So with water quenching glands, turn off the water supply while checking packing leakage. This is the only way to be sure that what you see is packing leakage.

Have each shift foreman and the maintenance foreman check the daily log at regular intervals. Only then will it serve its intended purpose. This helps spot trouble before it occurs, allowing scheduled maintenance to replace emergency repairs. Log sheets often give long-term trends in operating characteristics. Information collected can often be plotted, making it easier to analyze.

Semiannual checks are more thorough than those made daily. They should show any troubles that might come up within the next six months. But this inspection should not involve any major disassembly unless it is necessary to maintain some part.

Inspect the stuffing boxes for free movement. Clean and oil the gland bolts. Examine the packing to see if it needs replacement. Disconnect the pump from its driver and check the alignment, correcting if necessary.

Drain the oil from oil-lubricated bearings. Wash out the oiling system and refill with new oil. Check grease-lubricated bearings to see that they have enough lubricant in the housing and that it is of suitable consistency.

Annual checks should be far more thorough, even though the pump need not be dismantled. In addition to the semiannual steps, remove the pump bearings, clean and examine for flaws. Wash out the bearing housings, reassemble and add new lubricant.

While the bearings and packing are completely removed, check the rotor vertical movement with a dial indicator. This gives an indication of wearing-ring wear. Ring replacement and restoration of clearances can be scheduled if required. Also, spare parts needed can be ordered. When reassembling the bearings be careful to locate the rotor properly in its axial position. Follow the manufacturer's instructions in this work.

Shaft sleeves are subject to much wear and may require frequent replacement. After a sleeve wears appreciably, it is impossible to adjust the packing to prevent excessive leakage. Badly worn sleeves frequently tear and score new packing as soon as it is inserted. Thus, sleeves often need repair or replacement when no other part of the pump must be overhauled.

Sleeves can be easily removed with the help of a puller, Fig. 1. If sleeve is extremely tight and there is an impeller nut between the sleeve and adjacent impeller, the nut can be used to back off the sleeve slightly, thereby loosening it. When a sleeve is rusted to the shaft it is generally also badly worn and ready to be discarded. Use a hammer to expand it or crack the sleeve to aid removal. But be careful not to damage the shaft because it is extremely expensive to replace.

Some sleeves are reconditioned by welding or metal spraying, followed by a final grinding. But this is not recommended if pump service is severe or facilities for final grinding are not good. It is necessary to assure concentricity of grinding and perpendicularity of the sleeve's radial faces with the bores.

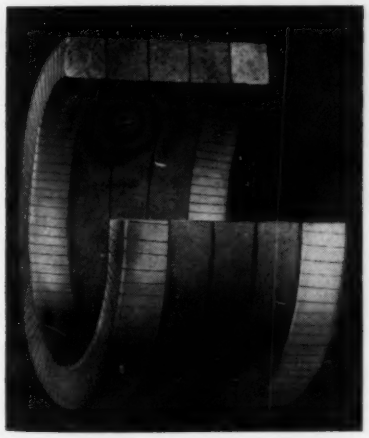
DAILY LOG SHEET

BOILER FEED PUMPS

MONTH & YEAR _____ PUMP NO. _____

DATE	UNIT LOAD KW	SUCT. PRES PSI	SUCT. TEMP °F	DISCH. PRES PSI	MTR AMPS	FLOW LBS/HR	BEARING TEMP-°F INBOARD	BEARING TEMP-°F OUTBOARD	LEAKOFF LBS / HR	REMARKS
1										
2										
3										
4										
5										

2 Daily log sheet, wisely used, can be your key to troubles that may soon occur in your centrifugal boiler-feed pumps. Use it correctly and it will save work



3 Typical preformed packing rings as used in a modern boiler-feed pump

feed pump performance

Check concentricity again after sleeve is assembled on the shaft.

If sleeve wear and grooving are minor —say, under 1/32 in., and service is not severe, it may be possible to refinish by grinding it slightly undersize. If this is done, check the clearance at the bottom of the stuffing box between the sleeve and casing or throat bushing. Be sure the packing will not be forced through the enlarged clearance space into the pump when the gland is tightened.

Stuffing-box checks made every six months should include several items. See that enough adjustment of the gland is possible for the next six months. Gland should not bind on the shaft, nor be cocked. Clean and oil the gland bolts. Annually, replace all packing. Check the sleeves to see that they are smooth and won't tear the packing.

Repacking a stuffing box should follow a standard procedure. Here are a series of steps that are effective.

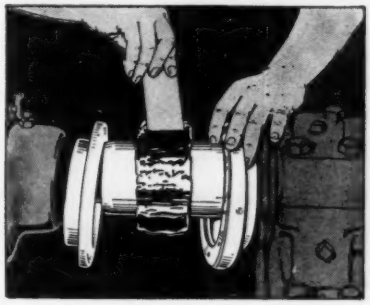
(1) Remove all old packing; clean box. Never add one or two rings of old packing—it's false economy. (2) Check to see that the packing is suitable for pressure and temperature in the pump. Cut each ring square on a mandrel, unless the packing is preformed. (3) Insert each packing ring separately, pushing it squarely into the stuffing box and seating it firmly. Stagger rings so joints are 120 or 180 deg apart. A split ring can be used to push the rings home, if desired.

(4) Locate the seal cage directly under the liquid supply connection, being sure that addition on one or more rings will not displace it. Boiler feed pumps use seal cages. (5) After all rings are inserted, install the gland and tighten gland nuts firmly. See that gland is square in box.

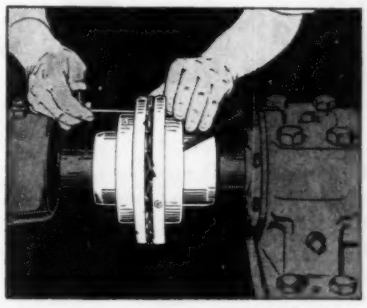
(6) Back off gland nuts until finger-tight. When running in new packing it is good to allow excessive leakage at the start. Take up on it slowly during the first few hours of running, possibly at 15-minute intervals. (7) Allow a steady stream of leakage from the packing, instead of a dribble, when making final adjustment.

(8) Check quenching glands, if used, as given earlier in this article. (9) Allow only trained personnel to repack and adjust stuffing boxes.

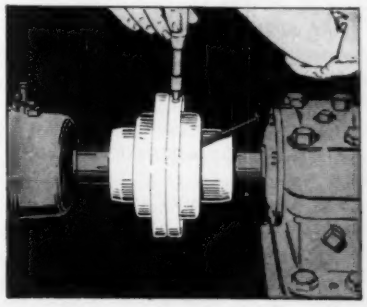
Couplings. Open, clean and lubricate all-metallic-lubricated-type couplings, Fig. 4. Use oil or grease the coupling manufacturer recommends. Check pin-and-buffer type couplings for wear. Pay special attention to rubber buffers or webs to see that there has been no loss of material. Align the coupling halves, using a straightedge, feeler and dial gages. Dial gage is used on extension couplings. Check the pump instruction book for the exact steps in aligning the coupling supplied with the pump. Then you'll know you're right.



4 Pack grease over grid and teeth, as here. Use as much of it as you can

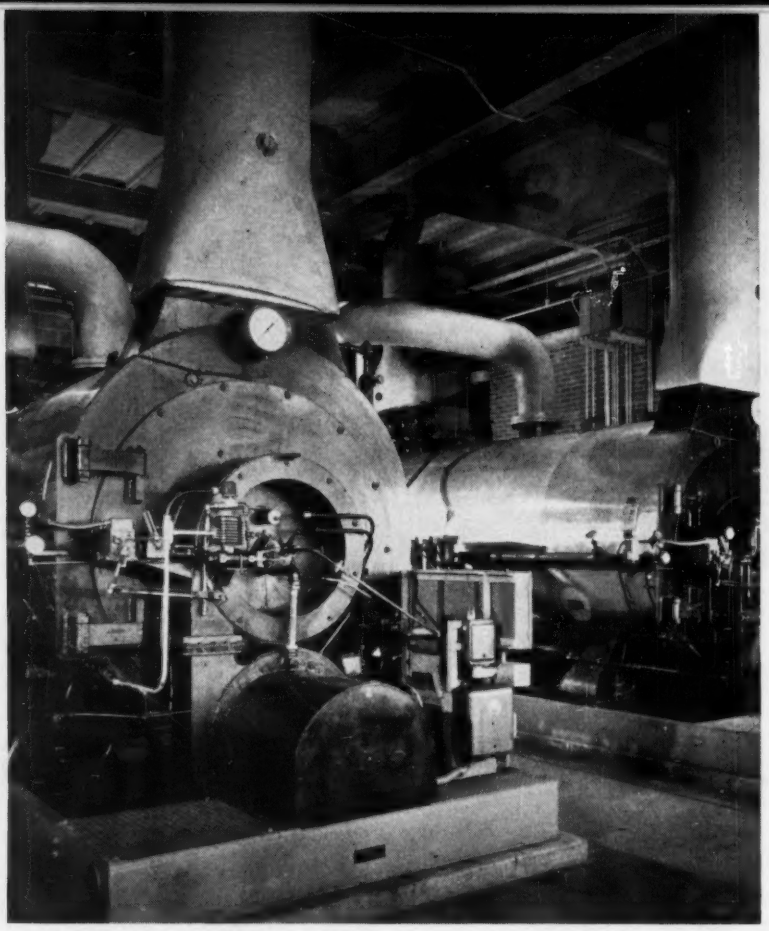


5 Draw up cover, fasten in place with its bolts. Add lubricant with a gun



6 Lubricate the coupling at least once every six months, using grease gun

AIR CONDITIONING



L-P HEATING BOILERS supply 12-psig steam for building heating, process

The small industrial plant stands to benefit from year-round heating and air-conditioning systems, says John Henze, plant engineer for The Mennen Company

Planned operations pay off for

► WONDERING whether your company should swing over to a year-round system for conditioned air? Initial operating costs got you worried? The Mennen Company's Morristown, N. J. plant met the problem head on. They've installed a relatively high-first-cost system. But in the long run planned maintenance, operating schedules make it a low-cost answer to their needs.

"By operating on 12-pound steam and setting up the boiler for automatic operation, the heating system works without permanently assigned operators," says plant engineer Henze. "And production departments rate the system tops."

The plant generates steam with two low-pressure heating boilers, above. In addition to supplying heating steam, the 12,500-lb-per-hr l-p boilers are used to feed process steam to jacketed kettles, heat exchangers, one 25-ton and two 180-ton absorption refrigeration machines. Warehouse and shops are equipped with 55 unit heaters. And 12 air-handling units take steam for winter operation. Summer operation also needs steam, for the absorption machines, photo, facing page.

Entire steam system is closed. Condensate returns to the boiler via three vacuum-return pumps. During summer condensate temperature rises because of absorption machines. So heat exchanger in the system reduces condensate temperature to keep it from flashing. The heat exchanger also supplies all domestic hot water for the plant's summer needs.

Temperature controls are an important part of the year-round system. The company has installed individual thermostats at key points throughout the different heating zones.

To insure continuous troublefree operation, engineer Henze has set up a carefully-worked-out maintenance program and sticks to it. Boiler-room log, facing page at top, keeps close tabs on operating conditions. Men take hourly readings that include: (1) steam temperature (2) oil temperature (3) gallons of fuel in the tank (4) stack-gas temperature (5) vacuum in the condensate-return system (6) hot-water temperature (7) pump pressures (8) absorption-refrigeration-machine temperature.

Filling out the log is a simple matter and takes less than five minutes to complete a routine recording. And it's a valuable record. Not only does it show up operating troubles but it also supplies management with vital data needed to figure costs.

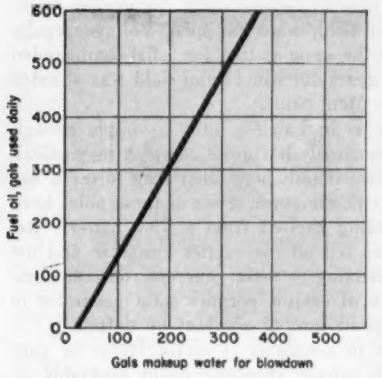
Men who fill out log sheets aren't regularly assigned to boiler-room operation either. They're maintenance men for the entire factory building.

Plant engineer Henze keeps his boiler room shut down at night—as long as

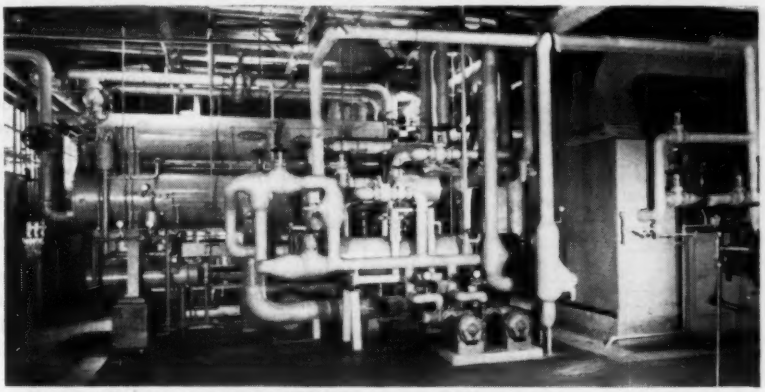
Date 9/1/55

Time	Boiler No. 1	Boiler No. 2	Steam Pressure	Oil Temp	Gals Fuel	Stack Temp	Vacuum Inches	Hot-water Temp	Compressor pressure No. 1	Compressor pressure No. 2	Compressor pressure No. 3	Secondary pump pressure No. 1	Secondary pump pressure No. 2	Absorption machine temp No. 1	Absorption machine temp No. 2
8:00	✓		12#	214°	6,775	420°	7	144°	105	100	90	29			44
10:30	✓		10	212	6,600	400	4	144	100	110	100	30			47
11:30	✓		10	214	6,575	410	6	146	100	100	85	30			46
1:00	✓		10	218	6,500	400	4	150	105	100	85	31			47½

BOILER-ROOM LOG is filled out hourly by building maintenance men. Data keep plant engineer posted on conditions



BOILER BLOWDOWN chart relates daily fuel-oil use to blowdown, makeup needed



ABSORPTION REFRIGERATION UNITS supply chilled water to air-handling units during the summer months. Two machines, rated at 180 tons each, use l-p steam

year-round conditioned-air systems

outdoor temperature isn't below freezing. A maintenance man checks the boiler during morning start-up. It takes about half an hour from start-up until the boiler is up to temperature at full load.

Typical of smartly planned operations at the Morristown plant is the manual blowdown and water-treatment scheme for the heating boilers. Both blowdown and water treating are carried out by building maintenance men during morning start-up. Procedure is based on a chart, lower left, that was worked out during boilers' shakedown period. It relates fuel oil used during previous day to blowdown needed to keep boiler in top shape.

Here are instructions that operators follow in using the chart: (1) Read fuel-oil tank first. Subtract morning reading from previous morning's reading. This is gallons of oil used. (2) Look at chart to get gallons of makeup water. (3) Read water meter in makeup line. (4) Open blowdown valve. Blow down boiler until the approximate water quantity from step (2) is removed from boiler. (5) Check water-meter reading to see if makeup agrees. If it doesn't, blow down longer. (6) Add half pint of internal-treating solution for each 100 gallons makeup water.

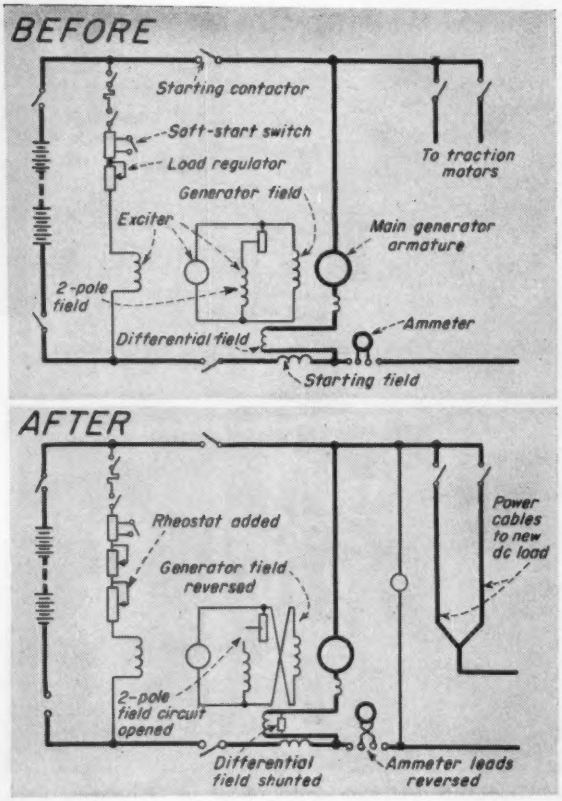
When outdoor temperature is freezing, or close to it, boilers run at night. So operator's first morning duty is to install a clean nozzle. Boilers fire No. 6 oil. But a 275-gallon tank of No. 2 oil connected to the fuel system is used once a month to flush oil lines and remove sludge from oil heaters. Flushing eliminates need to dismantle heaters, lines for cleaning.

Weekly maintenance is mainly to keep boiler room clean. Boilers' firesides are opened every three months to punch tubes, remove accumulated soot. Mennen also takes advantage of this scheduled outage to check and patch loose or cracked refractory with plastic chrome ore. Opening upper manhole to see the waterside will spot possible corrosion.

Twice-yearly inspection keeps watch on condition of moving parts. If maintenance men find oil, dirt accumulation they take units apart, clean and lubricate them.

About 200 thermostats are part of Henze's heating, air-conditioning system responsibilities. Twice-a-year testing includes resetting controls and watching action on control valves. If valve action is OK, operator calibrates control and resets the thermostat.

Over 300 automatic valves also receive semiannual test for lubrication, air leaks and steam leaks. Faulty valves get top-to-bottom overhaul of their stems, seats, bonnets and ports. Reheat coils in air-handling units are tested, vented once during the heating season.



CIRCUIT CHANGES for transforming diesel locomotive into an emergency dc source are simple. Original hookup for one type unit, top, needed reversal of generator field, new rheostat, shunting of differential winding plus exciter-hookup changes

Diesel locomotive subs for dc source

By **W W WOOD**, *Transportation Design Engineer, and*
C R KINGSTON, *Regional Transportation Engineer*
Westinghouse Electric Corporation

► QUITE OFTEN only a simple change in circuitry transforms a diesel-electric locomotive into an emergency power plant, capable of delivering a reasonably constant dc voltage. And the setup can be depended on to carry the load for an extended period without harm to locomotive. Modifications are simple, require little time, and all the additional equipment you may need is a rheostat. Sketch above shows wiring changes needed with Baldwin-Lima-Hamilton locomotive.

A few years back this arrangement came in mighty handy during construction of U.S. Steel's Fairless Works in Fairless Hills, Pa. Overhead cranes had been installed and were needed during building of mill proper. But rectifiers that would normally feed 250-v dc to cranes weren't scheduled to arrive for another seven months. That's how a switcher locomotive was pressed into service.

Switcher operated as an emergency power plant for the 7-month period, then returned to normal locomotive service. Checkup showed the emergency stint did not harm the unit.

One diesel-electric switcher locomotive is designed so generator supplies between 30 and 1000 volts to the drive motor. Currents may fall anywhere from 2000 to 800 amp. Yet even with generator's variable-voltage characteristic a simple change in connections gave essentially constant output voltage. Change involved swinging the main generator hookup from differential to cumulative. To do it the exciter leads, feeding the generator field, were swapped. Voltage regulation wound up about the same as that for a flat-compounded machine after main generator differential field was shunted with 57½ in. of 500 Mcm cable.

Generator exciter, as in Fairless unit, is simple enough mechanically and electrically but quite complex magnetically. We won't go into the details here other than to say it has six poles with a 2-circuit armature. Four of these poles have a normal shunt winding excited from a 75-v battery. Remaining two poles are fed off the exciter armature and the differential field connecting to main generator output. Complex magnetic nature of exciter permits main generator to automatically produce its normal constant hp output.

Armature reaction in generator is major factor in poor voltage regulation. A voltage regulator could profitably be used. But usually a simple rheostat, inserted in exciter's main field circuit, permits close manual control of voltage. Differential field is converted by polarity reversal (see sketch) into a cumulative field. Then about three quarters of that field current is shunted out by a length of cable, providing compounding for better voltage regulation.

Changes involved take about 4 hours, varying with the specific type locomotive. Although no new equipment is needed other than the rheostat, a portable voltmeter is recommended during the hookup and final checkout.

Best operating speed is another variable to be checked with locomotive builder. He can supply you the optimum figure if you tell him maximum and average load needs. On the Fairless job a 520-rpm engine speed was chosen on the basis of a 2000-amp maximum current. Thinking was that should this current figure be exceeded, engine speed would drop through overload. Arrangement served as a form of protection since overload relays are not normally provided on diesel locomotives. If plant load circuit is equipped with overload protectors, so much the better.

Engine speed in one case was upped to 600 rpm for heavy loads, while for light loads (100 amp) an idling speed of 315 was approved. By varying the 4-pole field current with the rheostat, and choosing different lengths of cable to shunt the differential field, current and voltage were adjusted for any speed within the normal operating range.

Seeing that mighty expensive equipment is involved, it's best if you supervise the circuit changes. Keep in mind that actual wiring changes will vary with different type locomotives. So the sketch shown above will not hold true for all cases by a long shot. Use these hints merely as a guide, checking closely the wiring diagram for the particular locomotive being reconnected.

Real dollar-saving tip might be to have a field-service engineer, representing the equipment builder, on hand the first time you try this setup. He's best qualified to supervise the actual changes and check final operation.

Inert-gas-shielded arc weld proves practical for . . .

Joining aluminum sheath on high-voltage cable

► SOME MONTHS have slipped by since the first installation of an insulated power cable with aluminum sheath and welded joints. Normally power cables are lead covered. This aluminum-sheathed cable, installed by Niagara Mohawk Power Co in the city of North Tonawanda, N.Y. is a new arrival to the power-cable family. Apparently, welding the sheath was a problem until the inert-gas-shielded tungsten arc process was used.

Conductors are 350 Mcm compact-sector copper, with 240 mils of shielded impregnated paper on each conductor. Metalized paper tapes surround each of the three conductors. Cable was bought in 1000-ft-reel lengths and suspended from 7/16 in., 7 strand, Class C galvanized-steel messenger. Stainless-steel straps having an ultimate strength of 800 lb were used. They are compatible with the 2S and 3S aluminum alloy in cable sheath.

Satisfactory weld required oil within cable be held off welding surface. At same time welding heat must be kept from damaging insulation. Both objectives were served by sliding a 4-mil metal shield between sheath and core, packing several strands of dry asbestos string between sheath and metal shield. Added cooling was had by placing a wet rag on cable sheath during welding.

Welding end bells to flared cable sheath was first jointing operation. Once this was done, conductors were spliced. Next came welding of sleeve to end bells. This was a simple lap joint. All welds were started at cable bottom so under-half of cable assembly was welded first. This means cable oil is kept under control, away from weld area.

Where will aluminum sheathed cable fit into the industrial-plant distribution setup? It's any one's guess at this early date. But their lighter weight and high resistance to vibration fatigue may see them applied in several areas within the plant proper. Cost should be a factor in their favor.

Corrosion plugs aluminum conduit buried in concrete

► TROUBLE STARTED a few years after aluminum conduit was laid in concrete during construction of a hospital in Smith Falls, Ontario, Canada. First sign of corrosion came when an electrician couldn't pull wire out of a conduit laid in concrete. And within seven years after the first conduit was installed (construction began in 1946) some four cases had been spotted where corroded conduit walls had collapsed, jamming wires snug.

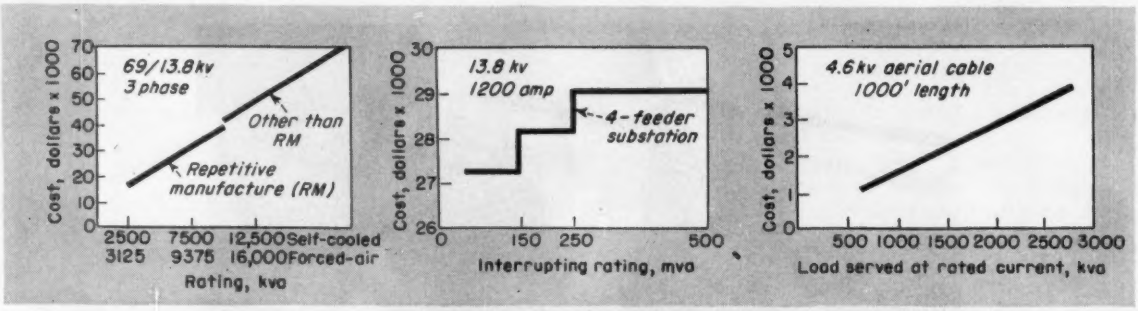
Corrosion problem with aluminum buried in concrete was theme of paper, presented by T E Wright, Aluminum Labs Ltd, before the National Assn of Corrosion Engineers last fall in Montreal. Wright's lab report indicated that aluminum imbedded in concrete normally suffers but mild superficial corrosion during concrete's setting period. Corrosion, at least in theory, is so slight that aluminum conduit requires no protective coating unless the concrete remains damp. Once set, conduit in the hospital was expected to remain dry.

Corrosion products dug out of the hospital floor brought to light some interesting facts. First, since *Alcan 3S* (from which the conduit was made) contains manganese, the pink corrosion products were probably the result of oxidation. Second factor was the acidic water extract. Both conditions together suggested a corrosive condition much the same as if conduit surface were acting as an anode.

Analysis of concrete indicated no waterproofing or other agents were added, with the exception of calcium chloride used during cold-weather pouring. Amount of calcium chloride hinged on a foreman's judgment and the weather, but should not have exceeded 2% of the portland cement content.

Galvanic corrosion study showed the voltage between conduit and ground measured 0.6 in one spot and 0.4 in another *with conduit negative*. This setup was all in favor of corrosion.

What can be done? Since corrosion under given conditions couldn't be prevented for certain by painting conduit beforehand, and since steel is always found in such structures, it's smart to avoid burying aluminum conduit in concrete containing calcium chloride.



POWER TRANSFORMERS | METALCLAD SWITCHGEAR | DISTRIBUTION CABLE

Rough-cost figuring for distribution equipment

► EVER SEARCH for quick figures on major electrical-equipment cost? Simple curves above give you numbers for talking purposes. But remember they're only initial cost figures.

By failing to consider future costs you can run into trouble. Example: Industrial plant considers installing its own primary substation. Immediate load is 12,000 kva, but 6000 more is shaping up. Additional investment in transformer alone to serve tomorrow's load costs $17,800. But deferring construction would mean spending $25,250 later.

A method of evaluating future costs and giving them their proper weight was theme of paper by H B Backenstoss of Jackson and Moreland. Paper was presented before AIEE General Winter Meeting, Jan 30, 1956 in New York. It's heavy with mathematics but thorough in coverage.

Emergency lighting needs met with ten 50-w lamps

► WHEN LIGHTS FAIL in a busy plant, anything can happen—accidents, panic, pilferage, equipment damage. Even with the increasing adoption of automatic equipment, adequate emergency lighting is still needed. We took a step in the right direction when we rigged up a 500-w generator for the power plant.

After a quick planning session, we figured ten 50-w lamps, well placed, would meet our emergency lighting needs. Lamps were spotted at boiler feed pumps, deaerating-heater gage glasses, stairways, the f-d fans, service-water pumps and their controls.

Power supply for this lighting setup comes from a steam-turbine-driven 32-v generator salvaged from a plant locomotive. Unit is rated at 500 w. We installed it on the same concrete base that supports the feed pumps.

In hooking up we used a ½-in. steam line, ¾-in. drain and 2-in. exhaust. Generator is protected with a set of 15-amp fuses. Maximum steam pressure is 200 psi; set has a speed regulator on steam inlet to turbine. A few seconds after opening steam valves, unit is generating and drain valve can be closed.

ART BELDON, *Montreal, Canada*

EDITOR'S NOTE: *The 6-v emergency-lighting battery-operated unit* (POWER, *Feb 1955, p 92*) *appeals to many engineers. Here each unit flips on automatically when normal power fails. A trickle charger keeps battery up.*

Fluorescent lamps can be a problem at low temperatures: Here's why

► YOU WON'T BE SATISFIED with fluorescents operating outdoors in cold weather, or in refrigerated sections of your plant, unless they start positively and produce a useful amount of light once they get going. There are several combinations of lamps, ballasts and starters that give reliable starting down to 0 F. One practical table of suitable combinations can be had by writing the Large Lamp Dept, General Electric Co, Nela Park, Cleveland 12, Ohio: Ask for Volume 111, No. 5 of *The Lighting Engineer*. It's free.

But getting the lamp started is not enough. You must also consider light output. Lumen rating of most fluorescents holds for operation in still air at 80 F. If surrounding air is much above or below that figure, light output for all but the high-output lamps is greatly reduced. At 0 F most fluorescents produce less than 20% full light output, even less if exposed to drafts. So don't operate fluorescents bare if they're outdoors in cold weather. They may start, but won't give enough light.

When lamps are in fixtures they give a much better account of themselves. If the fixture traps any air at all, lamps will soon heat it to some temperature higher than the surrounding air. If fixture is totally enclosed, so much the better.

We mentioned that high-output lamps were not affected to the same degree as most fluorescents. Reason: Higher current loading of the lamp means more air will be heated. That's why the new high-output rapid-start lamps, operating at 800 ma, are logical choice for outdoor service. They give a maximum light output between 50 and 60 F. So at lower temperatures their percent output is higher than for other fluorescents.

A filament lighting system may be your best bet for an outdoor setup that operates only during the cold weather. Consider this angle by getting a ratio of the cold to mild nights for a few recent years in the area where an installation is being planned.

What's new in silicone insulation

- **Silicone-enameled magnet-wire bids for Class-H rating**
- **NEMA sets 220 C as Class-H transformer's hot-spot limit**
- **Silicone-asbestos-glass slot liners are slipping in as replacements for glass-mica-glass in some motors**

► IN RECENT YEARS, Class-H silicone electrical-insulation systems have made some significant strides forward. These include improved silicone varnish, curved top sticks for motor slots, silicone asbestos-glass slot-cell liners, plus silicone-enameled magnet wire. These are but a few in a growing list (POWER, June 1955, p 82-85).

Shortly after each such development made its appearance, electrical manufacturers and rewind shops put it right to work. Result was some confusion amongst plant engineers as to precisely what they were getting when buying a new Class-H motor, or having an old unit rewound.

To help clear the air, C A Doremire, manager of Electrical Industry Sales for Dow Corning Corp, big producers of silicone products, sent a clarifying letter to customers explaining just what these new developments are, and their significance in terms of random-wound integral-hp motors. Following is a short version of Doremire's comments.

WHAT'S A SILICONE INSULATION?

Typical early silicone Class-H insulated motor was built with double-glass-served silicone-bonded magnet wire, silicone-bonded glass-mica-glass for slot and phase insulation, silicone-varnished glass cloth for coil-to-coil insulation. Top sticks and between-coil-insulation in slots used silicone glass laminate. Finishing touch was silicone-rubber lead wires and silicone varnish impregnant.

Using the above construction as their model, the AIEE in 1947 set 180 C as the maximum hottest spot temperature for a Class-H motor. Since then the Dow Corning people have proven by life tests, the 180-C figure is far too conservative. Their tests show a silicone-wound job, made up of double glass-served silicone-bonded enameled magnet wire, operating at 230-C hottest-spot temperature, gives a life expectancy equivalent to that of Class-A or Class-B motors, operating at their respective top temperatures of 105 C and 130 C. Two of the early test motors, wound in 1943, are still running at a hottest-spot temperature of 250 C, after seven years' actual running time.

WHY A 180 C TOP?

Reason for the conservative figure on maximum temperature can probably be traced to lack of thermal life data on silicone-insulated systems back in 1947. Indications today point toward recognition of a more realistic temperature limit, possibly in the 200- to 225-C range. A step in this direction was taken by the Navy some five years back when they established a 200-C top for their silicone-insulated motors. They place a 225-C hottest-spot rating on silicone-wound transformers. Just recently, the transformer group of NEMA set 220 C as the hottest-spot figure for Class-H dry-type transformers.

Now many motor manufacturers and rewind shops are using what they call a modified silicone winding. It is basically the same as former windings with one important exception: Silicone-enameled magnet wire has replaced the double-glass-served silicone-bonded magnet wire. This means use of an enameled magnet wire, similar in physical properties to *Formvar* or *Formex* but at least 80 C more heat stable. The self-imposed hottest-spot limit placed on the modified winding is 160 C. This is but a temporary measure until silicone-enameled wire is given a full Class-H rating by AIEE (POWER, Sept 1955, p 118).

OTHER NEW MATERIALS

Silicone-asbestos-glass slot liner is fast replacing glass-mica-glass in many applications. The former has a more uniform thickness and dielectric strength. It's also physically stronger and forms well. A thin flexible sheet of this material makes a good coil wrapper. Today it has a price advantage over mica-glass combinations. In this combination the asbestos is thoroughly saturated with silicone resin. Hence, it doesn't absorb excess water when faced with extreme moisture in the field.

Several manufacturers are molding silicone-laminated curved top-sticks. These are finding their way into motors as replacements for the flat-top sticks, which were cut from silicone-glass laminate stock. Curved-top sticks give better space factor in the motor slot and are more easily worked.

LOOKING AHEAD

A peek at the broader side of silicones was taken by C G Suits of General Electric, in a banquet talk before the AIEE Summer General Meeting. Silicon, the basis for silicone, is the most common solid element on the earth's crust. Rock is mostly silicon, bound tightly to oxygen.

Probably no material other than the silicones has been applied by engineers to so many diversified products in such a short period. Basic research on the silicones is speeding ahead as new ways are found to use the rubbers, resins and oils developed. Stability in face of high temperatures is still one of the more important properties of the silicones.

But, as pointed out by Dr Suits, there are many properties other than temperature resistance that are fast making the silicones adaptable to a variety of applications. Typical: A drop of silicone added to lubricating oil prevents foaming (POWER, October 1955, p 101), a little silicone on a bread pan or tire mold prevents sticking.

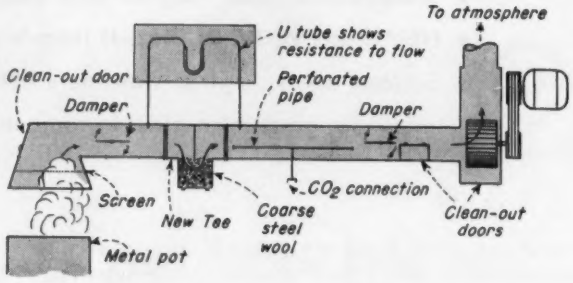
In the face of intense corona, silicone rubber has an amazing durability. It stands up for many thousands of hours where a natural or synthetic rubber would fail in minutes. Mechanical strength of silicone rubber is increasing yearly as structural secrets are discovered. Now it's in the range of the best natural and synthetic rubbers.

Latest PRACTICAL IDEAS to help you keep

No more cold feet

If one of the secretaries in your engineering office has cold feet, get her a foot warmer, photo. Also, your employes on the production line, in office or in lab can do more work with less absenteeism from colds if they keep their feet warm with one of these portable foot warmers.

Pads are 14x21-in. neoprene, throw off a gentle warmth that keeps the user comfortable. They are safe, use less power than a 75-w light bulb.—*Courtesy, General Industrial Co, Chicago.*



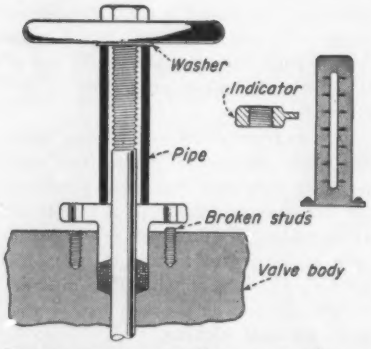
Fire in ventilating duct? Not now

Fire in a ventilating duct warned that our cleaning schedule and fire-prevention system weren't good. Accumulation of dust, carbon and oily residue provided fuel for a very smoky fire, lacking in flame and heat, but causing disturbance and discomfort. Because of smoke, access to fire with fire extinguishers wasn't easy. More frequent duct cleaning is expensive as it takes manual labor at overtime rate. Sketch shows our solution.

(1) We installed screen in hood over metal pot to arrest sparks. (2) Dampers were put in duct to isolate danger area in case of another fire. (3) Tee connection was made up and air stream directed through coarse steel wool in an easily accessible chamber to remove residues, etc. Glass U tube filled with liquid indicates resistance as steel wool becomes saturated. Steel wool can be used again after cleaning in degreaser and blowing with air. (4) We installed permanent perforated piping in duct with an external connection to CO_2 bottles to smother fires at once. We stop fan, close dampers, and turn on CO_2. (5) Additional cleanouts, sketch, are for more thorough inspection and cleaning to save time.

Now we have less manual cleaning and a better chance to fight duct fires.

H R MATHISON *Elmont, N. Y.*



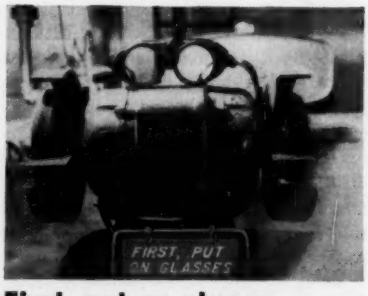
Emergency valve repair

Shortly after assuming duties as marine engineer, an operating emergency arose. To solve, we needed a standby steam-driven reciprocating pump. After lining up suction and discharge, opening drains and exhaust, lubrication and other preliminaries, I cracked open throttle. WHAM—a cloud of steam covered me as the valve packing let go.

We closed valve ahead and repacked throttle. This throttle valve was the internally threaded type with an outside open-closed indicator, sketch. Both studs holding packing gland were corroded and sheared off when I tried to remove nuts. But I had no time to remove frozen and broken studs.

We removed valve wheel and indicator rig, repacked valve and slipped a length of ¾-in. pipe over stem. Then I drove follower and packing firmly into stuffing box with pipe. Next I cut off the pipe slightly longer than distance between gland and underside of valve. I replaced wheel and tightened wheel nut. Closing in on valve would tighten packing. Now, we controlled pump from line valve ahead until plant trouble was corrected. Then one day we repaired valve with new studs.

H R MATHISON *Elmont, N. Y.*



First, put on glasses

Safety glasses, photo, are kept in position shown, except when they are on operator.

The little sign swings on wire hinges fastened to grinder frame. Switch for machine is behind sign. So if operator doesn't have glasses on he has no excuse as he has to swing the sign upward to turn on the grinder.

D L COCHRANE *Cambridge, Minn.*

production going at top speed

STEVE ELONKA, *Associate Editor*

Does it pay to have a 'scrap pile'?

Every firm that maintains equipment will save money by setting aside storage space for used material. Good parts of such material are useful to replace broken or worn-out parts. Many modern plants fail to provide such salvage and storage because it's often cheaper to replace the entire assembly than pay $3.00 an hour for a workman to dismantle and reassemble equipment.

Dollarwise that may be sound argument so long as the device is available in its original design. But improvements often make the first construction obsolete. Then repair parts become scarce and expensive. My experience in steam-electric plants shows value of saving parts, assemblies and even raw materials of components that were in active service.

We can't carry parts in stock for every item. The investment would be unreasonable and storage prohibitive. If used material is given space separate from new stock, then we can rob, cut up or discard anything stored there in making routine or emergency repairs.

Consider time lost by sending a workman for new stock at full cost when scrap will do just as well. Further, if he finds storeroom closed or item out of stock, then salvaged stock pays off in a big way.

Many small plants have only one maintenance man charged with upkeep of everything from replacing light bulbs to firing the furnace. This man already knows the value of hiding somewhere a few pipe fittings, bolts, wire, scrap lumber, etc. But often it's a fire or safety hazard and against rules. Besides, you need suitable space to keep parts orderly.

In saving used things for future repairs or replacements, the man who will use them is usually able to make a good decision about what to keep and what to discard. Any such program needs periodic cleaning out of surplus to keep housekeeping from becoming a nightmare. But I've found it justifiable in long run. It often pays dividends.

T E MILLER *Chattanooga, Tenn.*

EDITOR'S NOTE: *Do you readers have photos of stored "scrap" parts for these emergencies? If so, please shoot them to us and give some information.*

What would you have done?

We had just installed a new 100-hp packaged boiler for a hospital. Unit was gas fired and fully automatic. There was a receiver makeup tank and boiler feed-pump unit next to the boiler. After installing, the boiler was tested in operation several times. It was shut down at nights until hospital opened.

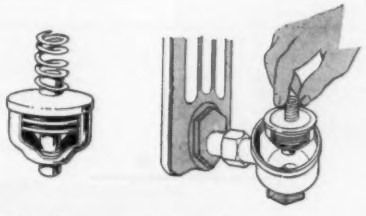
Everything operated smoothly the first week. Then things began to happen—always at night. I would be called out after warning buzzer started sounding. First night I was called out—everything checked out OK. After resetting, boiler's running was perfect. Next night the same thing—only called out twice. Each time everything checked out OK after resetting. I put recorders on line voltage, gas pressure, etc. But boiler water was always at right level when I arrived at plant. I began thinking of sabotage.

I sat up all night with the boiler to see what happened. Then I found the trouble. Not long after normal working hours, the boiler water went low and boiler shut down on low water. Checking why the feedwater pump didn't come on, I found it was stuck and very hot on water end. Then after all steam was off boiler, pump would cool and start running, filling boiler back to normal level. That's why everything checked out OK by the time I arrived at boiler after being called out.

What caused steam or hot water to run back to pump? A horizontal check valve between pump and boiler leaked slightly. When steam demand at nights was low, hot water from boiler would work to pump. Then overheating would bind pump. Pump didn't run often.

I installed a new vertical check valve in pump discharge line. No trouble since. What would *you* have done?

B H COKER *Lompoc, Calif.*



Replacement unit is the answer

R D Jones described his method of correcting steam-trap trouble, in Oct, p 140. He could have used a cage-replacement unit, made by Barnes & Jones Inc, sketch.

Cage-replacement unit has its own seat, and diaphragm with attached valve stem. Trap body doesn't have to be removed from radiator to install gage unit. Close radiator supply valve and remove trap cover, then remove diaphragm assembly from trap body. Set cage replacement unit in place and secure it with trap cover. Trap is then in good working condition. Cage units are made in many sizes to fit practically all traps.

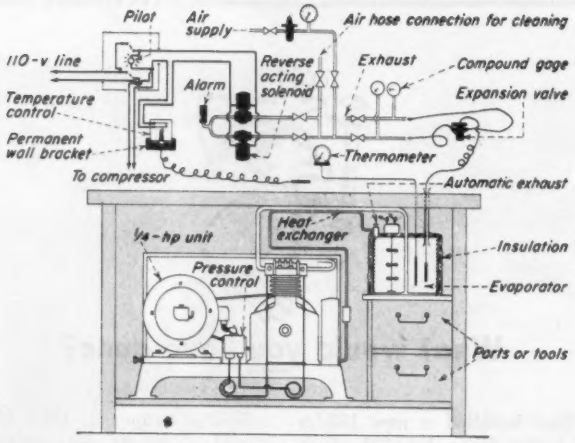
Jones does not say if he used old diaphragm assembly. If he did use the old one he had to cut down the valve stem and taper the valve to fit the new seats because of reduced clearance in trap body, and because of scored valve stems. If he had used new diaphragm assemblies, I'm sure he would have saved more money by using cage-replacement units. He would also have saved time as he would not have had to install new valve seats for traps.

J E DUNN *Bronx, N. Y.*

(*More Ideas on page* 132)

More PRACTICAL IDEAS

Begins on page 130



Here's your 'trick' of the month

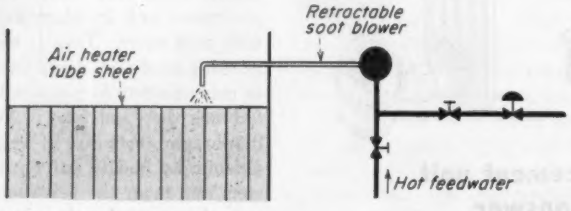
I dreamed up bench testing-unit, sketch, for controls while working as a refrigeration technician. Unit has been excellent for finding correct settings on various controls. We tested about everything going—it works wonderfully.

We made evaporator from sheet copper, ran coils around the wall and bottom, and used plenty of insulation. Whatever cooling medium is used in the evaporator must be the nonevaporating type. We used plain *Prestone* but lots of others would do. The agitator runs while the compressor is in operation, thereby keeping an even temperature around the bulb of control under test. An automatic expansion valve is used so different settings may be quickly made and thus save mechanic's time.

Using one reverse solenoid valve operates the alarm when the temperature control under test *makes*. Other solenoid operates the alarm when the control switch *breaks*. Therefore, you can watch the temperature or set the control without watching the switch contacts to see when they make or break.

Expansion valves or pressure controls may be set with the gages shown. Two lengths of flexible charging line connect these controls. Small clips are used on the temperature controls to avoid bending wire every time a control is changed. All air lines should be half-inch hard-drawn copper tubing for easy installation. Unit soon gets out of shape with soft tubing, as I discovered.

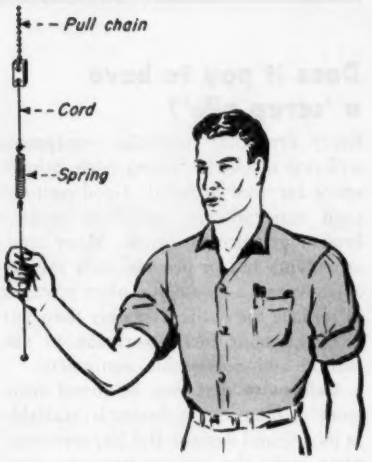
J R Hines *Croydon, Que.*



Air-heater tubes are clean now

Flyash plugged the air heaters in our kraft-pulp mill. Retractable straight-line automatic soot blower is on each side of air heater. We piped deaerator feedwater to the soot-blower steam line, sketch. Now when mill is down or we aren't incinerating "liquor," we turn 290-F water into the air-heater soot blowers, operate them manually until the wash water appears clean. It's effective and simple to operate.

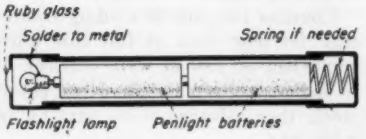
R Achzizer *Maryville, Wash.*



Now our light cords don't break

You can prevent electric-light pull cords, chains or switches breaking. Simply cut the present pull cord in two and tie both ends onto a tension spring, sketch. Any excessive pull on cord is absorbed by spring, thus saving it.

F Lettino *Astoria, N. Y.*



Handy tester is easy to make

In many plants the tools and machinery are fed from an overhead bus-duct. Fuses are fastened in with bolts. My tester, sketch, is a very simple unit to test fuses while they are still in the box. If plant runs on 440 v, take a 440-v 60-amp renewable fuse. Remove the link, but keep brass screw ends.

Drill one end for a pilot light, sketch, install a flashlight bulb, and solder the thread side to metal end of fuse. Cover bulb with a ruby glass. Install two penlight batteries, screw the other end of fuse in against batteries—tester is ready for use. Remember, this tester is safe because when you open the switches for test, the power is cut off. You can also use it for 220 v by having a 220-v fuse case with one penlight battery. Pays for itself many times.

J S Veitch *Pottstown, Pa.*

(*More Ideas on page* 134)

Want control for Water Heaters, Heat Exchangers, Processes?

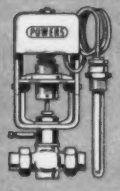
call POWERS

FLOWRITE
One of Powers Premium Quality Diaphragm Control Valves. They're simple, sturdy and dependable.

Over 60 Years of Temperature and Humidity Control

(c28)

You Will Insure Better Temperature Control IF— you use the right type regulator and proper size control valve. Whether a simple self-operating regulator shown at left is required or the air operated controls featured here . . . you can get both types and others from Powers. For further information call or write our nearest office.



Powers ACCRITEM Temperature Regulator and FLOWRITE Valve—the right combination for many control problems where pressure and load conditions fluctuate widely, also for control of large size valves.

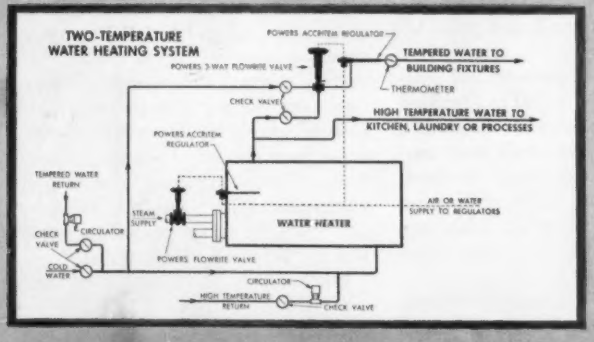
Over 50 Years Experience making this type of regulator

Control Point easily changed

Air or water operated

Ranges 50 to 250°F—150 to 350°F

VALVES: Available in a variety of body types and inner valves.



ACCRITEM TEMPERATURE REGULATOR

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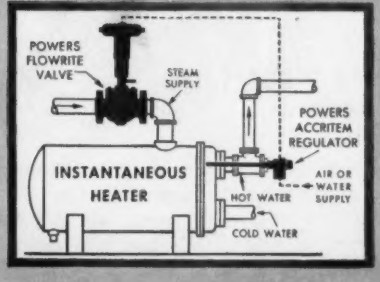
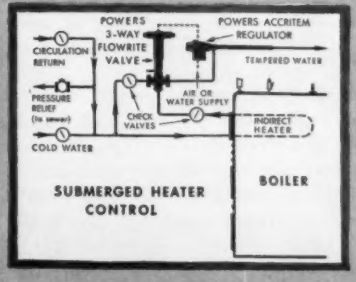
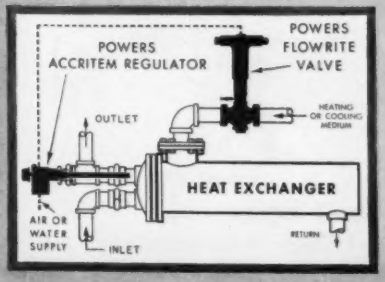
- Easy to Install • Direct or Reverse Acting, reversible on the job.
- Small Size: Regulator head is 2⅞" wide, 3⅛" high, bulb is 12" long with ½" IPS Connection.

Fully Described in Bulletin 316. Write for a copy.







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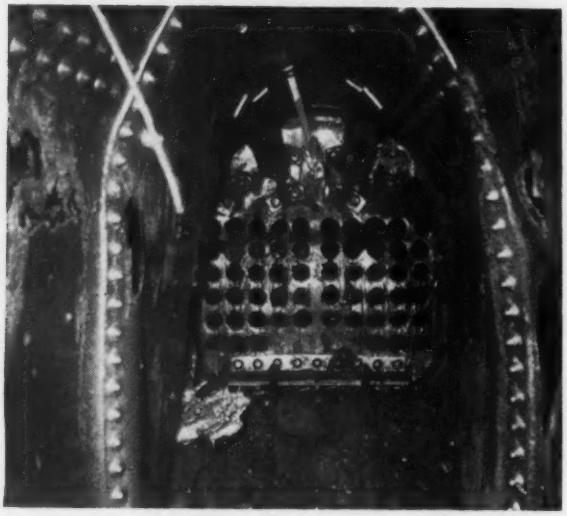
More PRACTICAL IDEAS

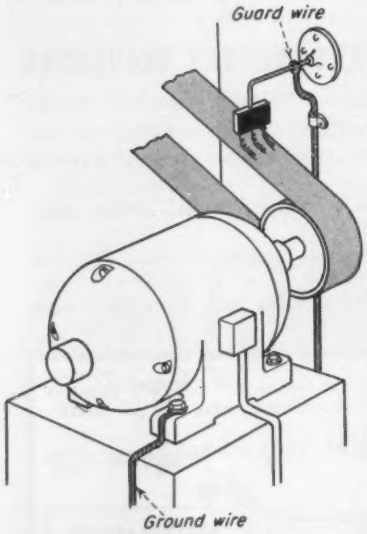
Begins on page 130



Don't let this happen to your boiler

This was once a horizontal-return-tubular boiler in a textile mill. Your boiler may look like this if you don't protect it against low-water conditions. Keep your low-water cutout and feed controls in proper working order. Test the low-water cutout at least once a day. Then take apart, clean and test twice a year. Be sure the control wiring and relays are cleaned and in good condition, also.

Oil burner on this boiler continued to burn after all water was out of unit. Shell and tubes were melted down into a slag. To prevent this happening to you, look inside your low-water cutout twice a year, and every day blow down to test.—*Courtesy: American Guarantee and Liability Insurance Co*



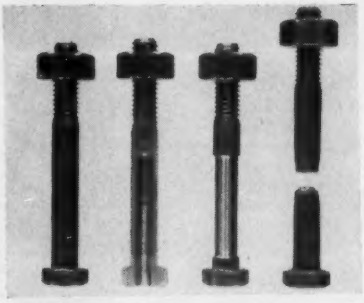
I don't agree . . .

with L Kasper on his method of grounding his pulley to lick belt static, in Nov POWER, p 132. His comb, placed on wrong side of pulley, can cause serious damage if it gets loose and falls between pulley and belt.

My sketch shows approved and time-tested method, see p 1717, *Standard Handbook for Electrical Engineers*, 1941. Suspend metal comb near surface, then ground this comb. At times, fine-wire springs are soldered to comb teeth and allowed to touch belt's surface, sketch. This method takes more attention because springs might break, but belt's surface is directly grounded. So it's maintained at a lower potential then when an air gap exists between it and metal comb. Grounding is very important as protection depends on easy path to earth.

If possible, connect ground wire to water pipe with a clamp and attach wire to a clean place on pipe. Be sure to clean pipe with abrasive cloth before clamping. Install ground wire so it's protected from damage and thus won't fail when needed. Dress belt's surface with nonstatic belt dressing to prevent static potential building up.

F A ANNETT *Flushing, N. Y.*



Removing metal livens bolt

Here's unusual way to increase strength of bolted joints when under shock loads. Remove precise amount of material from bolt shank, photo, thus reducing shank to certain optimum sizes. This depends on bolt type, method of manufacture and heat treatment.

Although bolts so modified weigh less, they can absorb several times more impact energy than ordinary bolts. This property may prove valuable for combustion engines, railroad-car carriages, rock crushers, other machinery subject to sudden and repeated shock loads.

Besides remarkable increase in impact strength, modified bolt with reduced shank allows greater stretching or elongation during tightening. So nut is less likely to loosen because of vibration. Also, resistance to fatigue failure goes up; bolt lasts longer.

First bolt in photo is ordinary machine bolt. Second is cutaway of optimum amount of metal drilled from shank's center. This modification produces same strengthening effect as third bolt, which has same amount of metal taken from outside of shank. Last bolt shows effect of removing more than optimum amount of metal from bolt's center. Here, more than maximum impact was applied until bolt snapped.

PROF O A PRINGLE *U of Mo.*

My biggest boner . . .

is now part of Practical Ideas but you will find it in the back of POWER. Be sure to send in yours—we all pull a boner at times. Only guy who never pulled one is Marmaduke Surfaceblow—but we can't all be perfect.—*Ed.*

Please turn to page 216

YARWAY picked for "Preferred" Steam Generators

This installation of Preferred Utilities Mfg. Corp. packaged unit steam generators at a high school in New York State features YARWAY Blow-Off Valves as part of the "package".

Not only Preferred Utilities, but many other leading manufacturers of package-type boilers now furnish YARWAY Blow-Off Valves on their units. YARWAYS make a *good* package boiler *better*.

The YARWAY Seatless Valve gives drop-tight shut-off and also eliminates the commonest source of blow-off valve trouble. *There is no seat to score, wear, clog or leak.*

Whatever make boiler you use, specify that the blow-off valves be YARWAY *Seatless*. More than 16,000 boiler plants use YARWAY Blow-Off Valves—some for 35 to 40 years.

Write for full details in Yarway Bulletin B-426.

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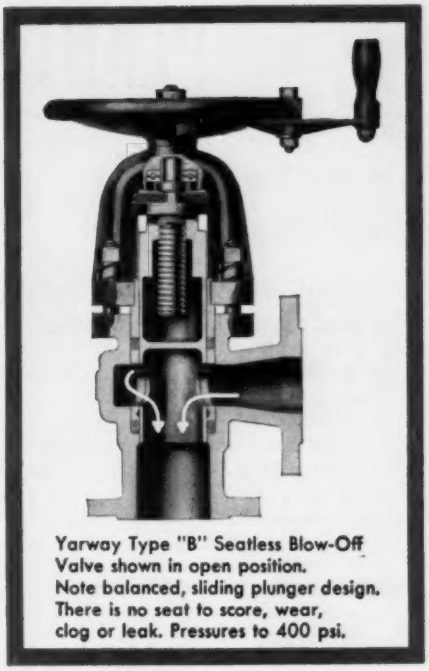
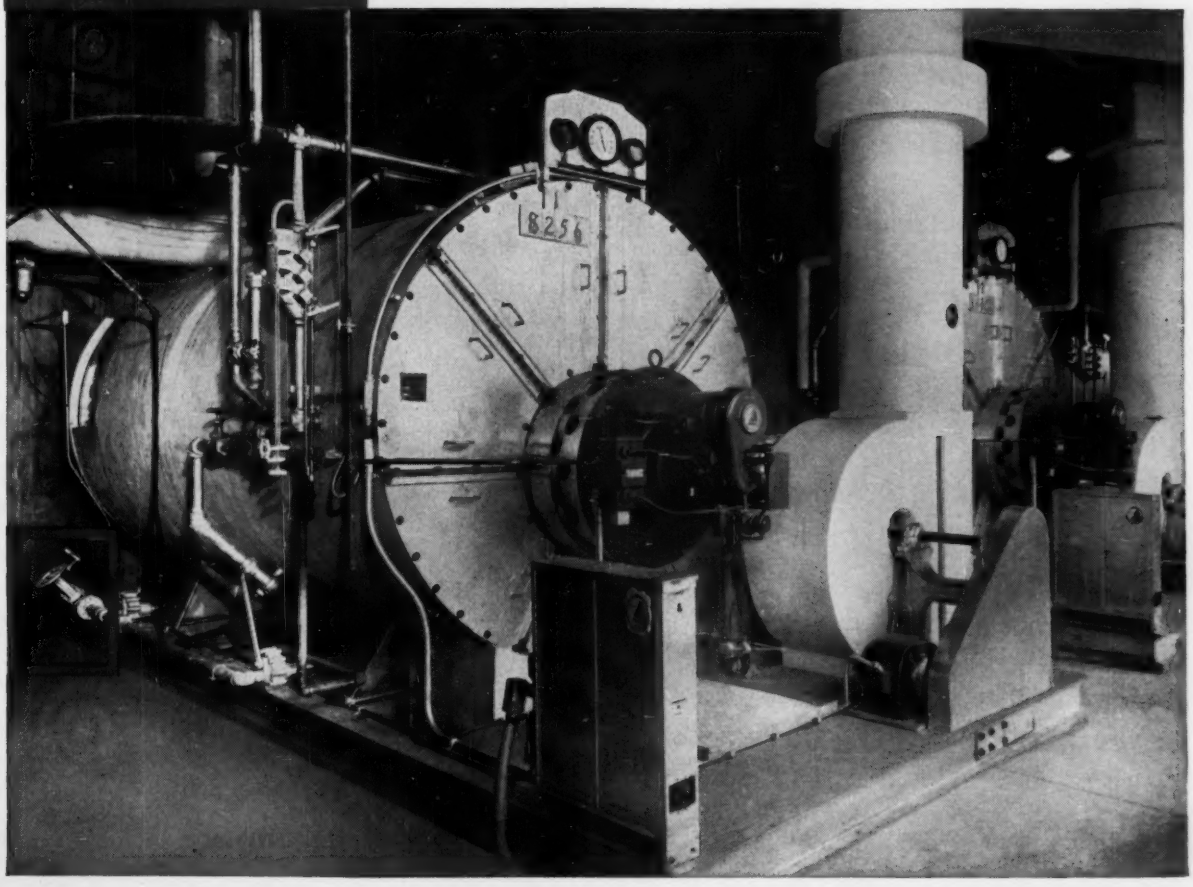


Yarway Type "B" Seatless Blow-Off Valve shown in open position. Note balanced, sliding plunger design. There is no seat to score, wear, clog or leak. Pressures to 400 psi.

YARWAY **BLOW-OFF VALVES**



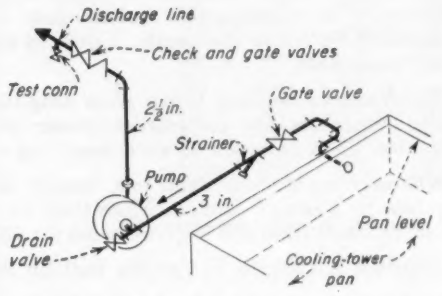
PLANT PROBLEMS... here is readers'

The question

How can we quiet annoying cooling-tower vibration?

THE FACTS: One of our cooling towers, drawing right, gives us trouble because of vibration noise near the circulating pump. In one of the offices along the line, noise is so intense, we can't live with it.

Pump and motor mounts are rubber cushioned, but noise persists. Can readers tell us how to quiet our system?—*JDC, Nov '55 Power*



The answers

Don't cushion vibration—eliminate it

Vibration *JDC* complains about gets worse when he places rubber cushions under motor and pump legs. Having absorbed vibration of the rotating elements, pump casing transmits it to the piping system. If piping system happens to be anchored in a way that makes resonance possible, vibration increases and the noise becomes loud.

Best remedy is to remove cause. Vibration may be due to (1) poor alignment of impeller and shaft (2) worn coupling disk (3) pump and motor shafts out of alignment (4) intermittent vacuum caused by air intake through the packing or in eddies, when water is low in the cooling-tower pan.

Second-best remedy is to hang the pipe from shock-absorbing hangers—especially at points near zone of offending sound. Hangers will help dampen the vibration.

O LE BRAGE *Oroville, Washington*

JDC's vibration is transmitted through piping or building steel

The so-called vibration can result from only two sources: Piping or building steel.

It's a common misunderstanding that just because a pump is set on vibration eliminators, they remove all vibration noises. Rigid pipe connections and fluid in piping, carry vibrations set up by pump. When this happens, break rigid connections and replace them with either a short piece of rubber or flexible metal hose. These dampen pump vibrations and will probably solve *JDC's* problem.

If cooling-tower-pan vibration is transmitted to building steel, the only effective cure is placing the cooling tower itself on vibration eliminators. Locate these between the cooling tower pan and supporting steel.

N FEDER *Flushing, N. Y.*

Vibration protection can backfire

JDC's vibration problem may be due to the rubber pump and motor mounts he installed to ward off just such a condition. Pump and motor are relatively free to vibrate on their mounts. The piping is rigidly connected at pump and tower pan. This setup plus long pipe runs could easily cause vibration noise. Motor and pump alignment could be thrown out of kilter by these mounts.

Partial plugging of strainer could also cause vibration. Better strainer arrangement is a screen at the tower pan.

B K PROBERT *Rialto, Calif.*

Clogged strainer may be the culprit

If *JDC's* strainer wasn't picked right, its cage may clog up easily. Also, bottom of strainer should have a flushout valve.

Be sure not to use a smaller-size flush valve than the tapped flange size on the strainer. It defeats thorough washing out of the cage, makes clogging more frequent.

C BACHMANN *Rego Park, N. Y.*

Trouble may be in pump

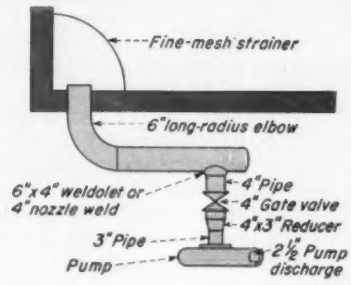
Poor shaft alignment, bearing and shaft wear or a worn impeller can cause vibration. But before taking pump apart to find out what's wrong, *JDC* should use a stethoscopic type of tool (Nov POWER, p. 132). It can pinpoint the trouble. A plastic-handled screwdriver, held against the ear, with working end against the machine, gives a good sound indication too. *JDC* will likely find his trouble here.

Also, check motor and pump mounting from the unit to the fastening point on the building. Trouble could be here.

D I COCHRANE *Cambridge, Minn.*

know-how put to work

HOWARD KALLEN, Associate Editor



Pump cavitation causes vibration

Fittings, valves in suction line causing pressure drop, plus a limited head of water in the cooling-tower pan, trim water supply to pump below safe levels. Resulting cavitation causes pump to vibrate.

Sketch, above, shows how suction line can be simplified to eliminate this trouble. If *JDC* can relocate his pump, I recommend that he run a straight pipe, without a 90-deg elbow, from the cooling-tower pan. Four-inch connection shown above is OK. Also, instead of a strainer in the supply pipe, install a fine-mesh strainer in the cooling-tower pan.

H T Livingston — *Los Angeles, Calif.*

Tip to *JDC*: Avoid trapped air in pipe

I would install a solid-steel plate about four inches above the cooling-tower-pan outlet, extending 18 inches either side of it. Clamping the plate snugly to inside of pan prevents formation of vortex that could funnel air to the outlet. Water level should always be above this plate.

If pan is shallow, boosting flow rate can drop water level, allow air to enter the pump suction. Ideal setup is a bottom-outlet deep pan, but *JDC* may have building limitations that don't allow such an arrangement.

Elbows close together, turned in different planes, cause water to have helical flow. They can also cut pump capacity, make noise. Some pumps make noise when they're run too fast for smooth operation.

Here's an experience we had: In a large hot-water system, noise traveled over 700 feet to the farthest building. With a tuning fork, we discovered that the noise matched middle C on the piano—a frequency of 264 cps. Pump coupling had six bolts. And nameplate speed was 2750 rpm. We realigned turbine drive and pump. Noise stopped. Realigning also eliminated excessive wear of bushings on coupling bolts.

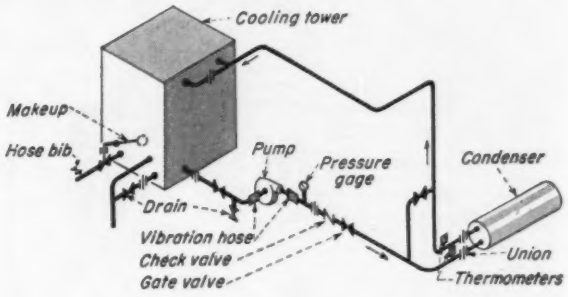
J A Graham — *Pittsburgh, Pa.*

Try rubber sleeves at pump

Trouble with the hookup shown is: It transmits pump noise through suction and discharge lines. If *JDC* installs a 2-foot rubber composition sleeve at pump inlet and outlet (similar to the connection on a car, from radiator to engine block) he'll eliminate noise due to pump.

Such sleeves can be bought ready to install. I've seen them withstand pressures up to 300 psi.

L M Martinez — *Jamaica, N. Y.*



8 points on right cooling-tower piping

Drawing above shows a cooling-tower piping arrangement that's troublefree. Here are eight points to check: (1) For minimum pressure loss, keep suction line short. (2) Suction-line pipe should be at least one line size larger than the pump connection. (3) Eccentric reducer at pump suction avoids air pockets. (4) Install strainer in the discharge line (not in suction) so head boost due to sediment collection is on pump discharge. (5) Check valve on discharge keeps pump from running backward. (6) Valved bypass is an optional feature. But it's often needed to balance flows. (7) Condenser water should enter bottom of condenser to keep tubes filled with water. (8) Flexible vibration hoses at pump suction and discharge help eliminate vibration.

H B Swygert, Jr — *Spartanburg, S. C.*

Frequencies of system and cushions may be in resonance with each other

Any piece of rotating machinery causes a force that repeats itself at a definite frequency. *JDC's* vibration isolator—rubber cushioned mounts—has its own natural frequency that depends on how much it deflects under load. To effectively isolate pump-motor vibrations, force frequency should be at least twice the natural frequency of the rubber cushion. When the frequencies are close to each other, they resonate (reinforce), producing vibrations that carry along the pipe and supporting structure.

Simple way to eliminate resonance is to relocate pipe hangers and supports, changing natural frequency of the piping system (so it's clearly different from the natural frequency of the vibration isolator).

H B Wayne — *Brooklyn, N. Y.*

I would install flexible metallic pipe

My solution would be to insert about 30 inches of 2½-in.-ID flexible metallic pipe or tubing between tee on pump suction and piping to cooling tower. If needed, *JDC* can also install a piece of flexible tubing between the outlet fitting from the cooling tower, and suction piping.

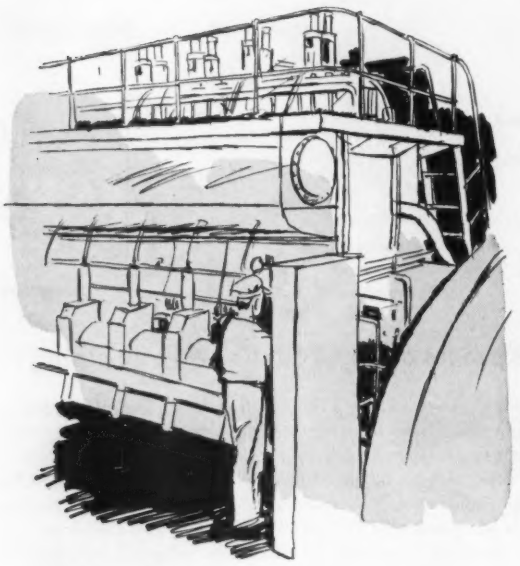
To get best possible results, hold the 2½-in. and 3-in. piping rigid. But let the flexible tubing move freely.

C McHardy — *Toronto, Canada*

Turn page for info on residual fuel in diesels

More PLANT PROBLEMS

Begins on page 136



The question

What's best way to burn residual fuel in our diesel plant?

THE FACTS: I'm superintendent of a municipal diesel plant that includes four diesels. Two are 1000-hp turbocharged machines running at 400 rpm. The other two are 500-hp noncharged engines that are running at 300 rpm.

We're now burning a relatively high-cost distillate fuel. Naturally we're always looking for ways to trim our operating costs and we've been giving consideration to switching over to the burning of residual fuel. But having had no experience with residual fuels, we're faced with some important problems: . .

What is a good hookup and what additional equipment do we need for burning No. 6 oil? Will extra maintenance wipe out our potential savings? Should we consider additives? Does blending with lighter oil pay? We'd appreciate getting opinions of readers on this matter.—*AL, Nov '55 Power*

The answers

Additive removes soluble compounds in residual fuel

With right fuel conditioning and treatment with an effective additive, it's possible to maintain wear and corrosion rates comparable to those found with distillate fuels. So extra maintenance need not wipe out potential savings.

Mechanical conditioning alone doesn't remove soluble compounds such as sulfur, vanadium and sodium. These elements must be counteracted by an effective additive.

Care in blending distillate with residual fuels is a must. It not only reduces savings, but if fuels are incompatible, sludge precipitates, creating a tough maintenance problem.

R S Norris *Larchmont, N. Y.*

Large-bore slow-speed engines needed for residual fuels

No. 6 or Bunker-C oil is used in large-bore (18 to 24 in. and up) engines operating at slow speeds (150 to 225 rpm or less). And fuel-injection system needs relatively large orifices. These are usually of marine-engine design.

Engines described by *AL* have minute orifices in the injection nozzles, making a clean, light oil imperative. I don't doubt that the engines will run on residual fuel. But maintenance of piston rings, cylinders and valves, to prevent carbon deposits, coupled with parts replacement, may offset fuel-cost differences.

I know of several instances where blending distillate and residual fuels was tried. But the blend wasn't as successful as heating and centrifuging residual fuel alone.

F A Butler *Dallas, Texas*

Experience at diesel plant of Minnkota Power Co-op

My dad, assistant manager of Minnkota Power Co-op keeps me posted on the conversion to heavy fuel at the Harwood, N. D., diesel generating station. Main purpose of the diesel plant: To handle peak loads and take over during overhaul periods at the steam plant.

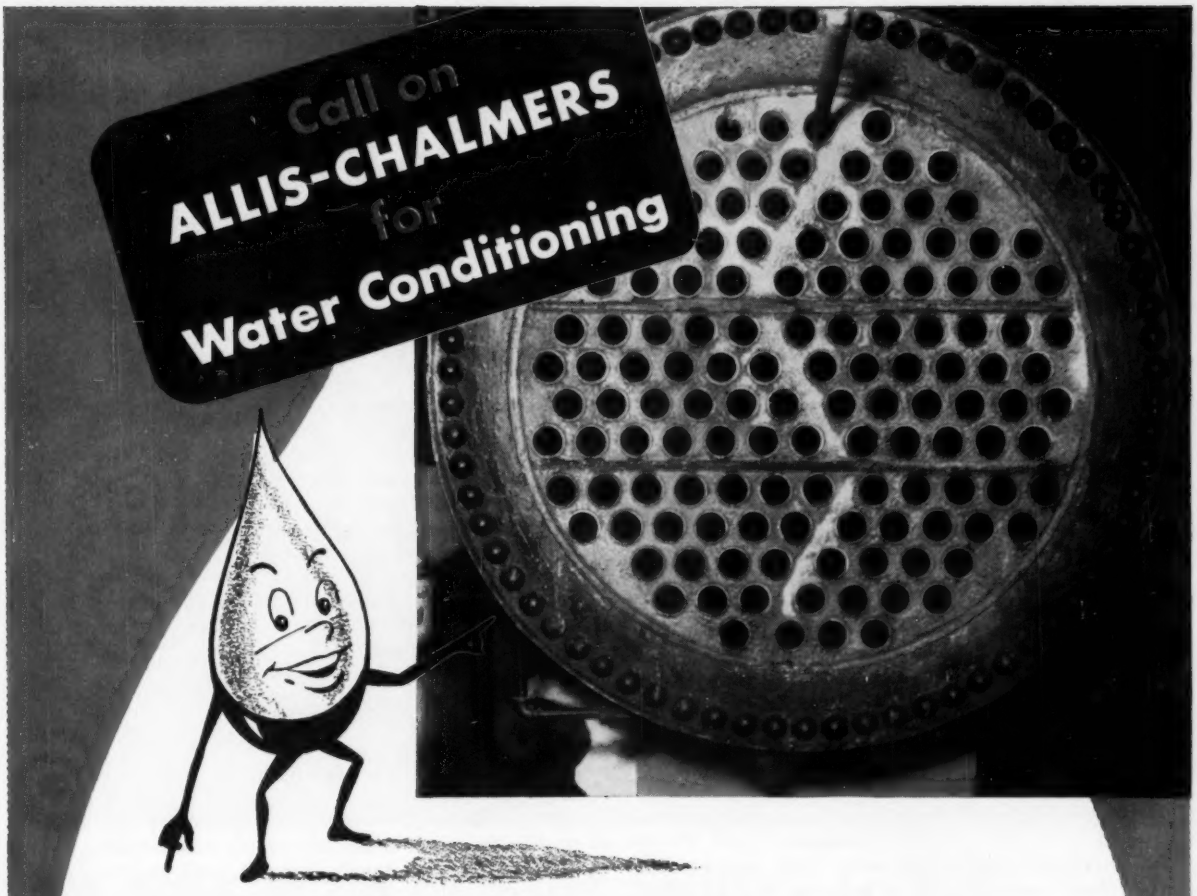
Conversion idea started when oil-company representative asked Minnkota to consider burning No. 5 fuel oil in its steam plant. Engineers soon found out that the heavy fuel couldn't compete with cheaper lignite used in boilers. But economy of No. 5 fuel looked good for the Harwood diesel plant—compared to burning distilled fuel.

Harwood's regular operating crew made the conversion. Electric heater, oil purifier and transfer pumps deliver clean, heated oil to high-pressure fuel bank—bypassing the day tank. The setup works fine. And Minnkota learned that engines could be started on heavy fuel.

Simple conversion for three engines cost $300. Savings on one tank car of fuel runs about $400.

H A Nelson *North Dakota State College*
M. E. 1956 *Fargo, N. Dakota*

For more on residual fuel and new problems, turn page



12 MONTHS OF CONDENSER OPERATION AND . . .

Absolutely No Scale or Corrosion

Always before, every year, a heavy maintenance job. Until this year, that was the story of the horizontal ammonia condensers at the 4th Street Plant of Terminal Refrigerating and Warehousing Corp., Washington, D. C. Now Allis-Chalmers chemical treatment has provided a new picture, shown above.

You can see for yourself — there are no signs of scale or corrosion. There are scars from cleanings after previous years' operation because it used to be routine to find fairly heavy deposits partially plugging most of the tubes.

After complete analysis of both incoming water and operating conditions, Allis-Chalmers water conditioning engineers provided a recommendation that resulted in a vastly reduced maintenance problem for the plant engineer. A-C engineers also advised on efficient means for introducing the necessary chemicals into the system.

For your own water problems, it will pay to take advantage of Allis-Chalmers experience. Get more information — or a specific consultation on your problems — by calling your nearby A-C office. Or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-4823

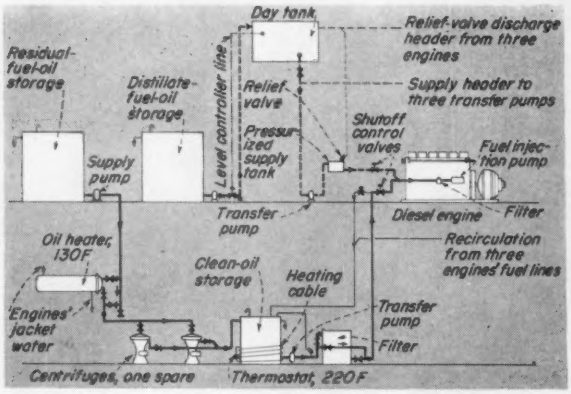
ALLIS-CHALMERS

WATER CONDITIONING—CHEMICALS, EQUIPMENT, SERVICE—FOR OVER 25 YEARS

A-C ALLIS-CHALMERS

More PLANT PROBLEMS

Begins on page 136



Potential savings are big but *AL* must heat, centrifuge fuel

Converting from distillate to residual fuel will yield substantial savings in *AL's* plant. If the annual load factor is 50%, then switching from No. 2 to 4 fuel saves about $18,000 a year. Swinging over to No. 6, boosts savings to $30,000. Bigger load factor, naturally, increases savings further.

Residual fuels also increase maintenance costs. Piston rings and cylinders usually wear faster. Also, good practice calls for fuel treatment prior to injection. Sketch, above, shows how the new residual-fuel system can be hooked up. Separate storage tank and supply pump push oil through to the clean-oil storage tank. Heating oil in the jacket cooling-water heat exchanger to about 130 F lowers viscosity, improves centrifugal separation from impurities. One centrifuge can do the job, but having a spare permits operator to isolate centrifuge and clean it without interrupting operation.

Blending distillate with residual is more costly than using straight residual. It lowers viscosity, allowing *AL* to use a smaller heat exchanger. But equipment needed is same as for residual alone.

AL should retain the present distillate-fuel installation, but use it only for startup and shutdown service. This system is tied into the residual-fuel system as shown in the sketch at left. When engine is brought up to full load, a fuel-supply control switch is energized to close the distillate-fuel valve and open the residual-fuel valve at the same time. The control could also start the light-fuel transfer pump when operating on distillate, shut it down when swinging over to residual. Recirculation control is also part of this circuit.

Recirculation line is a must in residual-fuel systems. It prevents settling of heavy-oil particles in the piping during low-fuel-demand periods. Continued settling causes sludge to form. Eventually sludge is pumped through, clogs filter and injection nozzles. That's why it's smart to swing over to light fuel just before shutting down. Sludge can't form in the engine and supply lines while the unit is out of service. And startup is aided by having distillate fuel in the engine's supply system.

Day tank shown in the sketch maintains a constant head on the transfer pump, keeping the supply tank at right pressure. The pressurized supply tank for distillate fuel does much the same job as recirculating line does in the residual-fuel system. Tank is ready to supply fuel when control valve opens, keeping the fuel oil-system operating smoothly.

A J Breugelmans — *New York, N. Y.*

YOUR FEBRUARY PROBLEMS

1 What should we look for in buying used boilers?

As plant engineer for a laundry plant, it's my job to supervise expansion of our already overloaded steam services. I figure that if we can add another 10,000 lb per hr to our 100-psi steam system, our plant will be in a good position to handle present steam needs as well as increased demand in the foreseeable future.

We've considered buying new boilers, but find that we can't stretch available funds. So we're now studying the possibility of buying used boilers. Naturally we want to be sure that we aren't cutting corners—saving a few bucks today, only to spend more tomorrow.

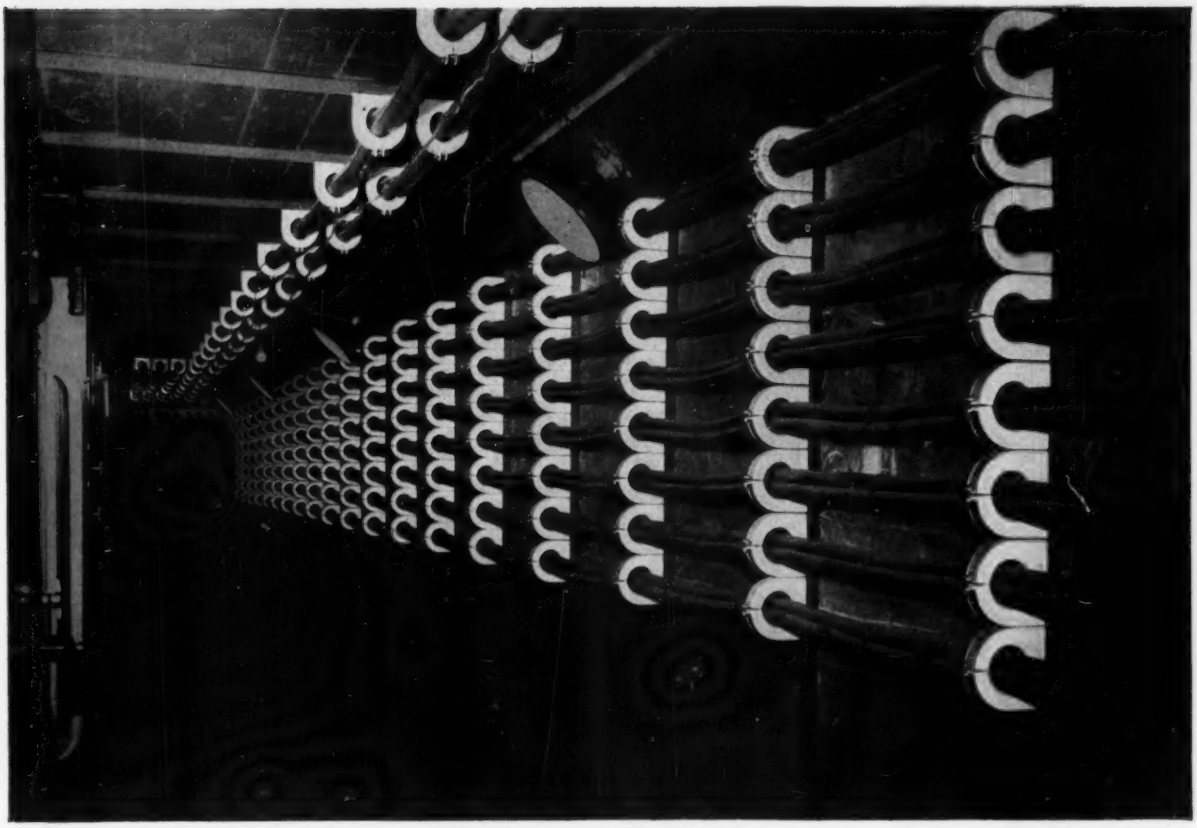
I've heard that just because a boiler shell is tight when operating under one set of water conditions, it won't necessarily continue to be tight under another set of conditions. And moving boilers from one location to another can change fixed stresses in boiler, bring on leaks, failure. I'd like POWER readers to give their experience on used boilers. What pitfalls should I watch for?—*KGD*

2 Why does insulation-resistance test give almost zero readings?

The turbine-generators in our plant have operated normally for many years at full load. But plant records show that repeated insulation resistance tests of field-rotor windings give us readings close to zero. Naturally, the condition has us wondering.

Can POWER readers tell us if this is a dangerous operating condition? What are the hazards of continued operation as is? What is a recommended minimum resistance reading? What's the best way to measure it? Is a megohmmeter test OK?—*CRW*

Sit down right now and answer one or both of these problems. We'll pay extra for answers with photos or sketches



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world's most modern shell plant specifies KEYSTONE 5KV CABLES

Available with either copper or aluminum conductors

Nothing was spared to provide the surest and most adequate supply of electrical energy for the huge motors, pumps and other equipment that make the Scranton Ordnance Plant, operated by the United States Hoffman Machinery Corporation, the largest and most modern of its type in the world.

In production less than 18 months after the project was approved, the plant makes extensive use of Keystone-Hazaprene 5kv non-shielded cable.

A typical application of this top-quality, yet economical cable is found in the plant's forge shop. There, 1/conductor 750,000 mcm Keystone-Hazaprene 5kv non-shielded cables feed power from 3 - 5000 kva transformers to 12 - 600 hp and 12 - 450 hp pumps which provide hydraulic pressure for the main drawing and forging operations. These dependable power feeder cables are installed in interconnecting underfloor tunnels like the one shown above.

You, too, can use Keystone cables to advantage in your operation. Ask for Bulletin H-463 for full details or write Hazard Insulated Wire Works, Division of The Okonite Company, Passaic, N. J.

2954

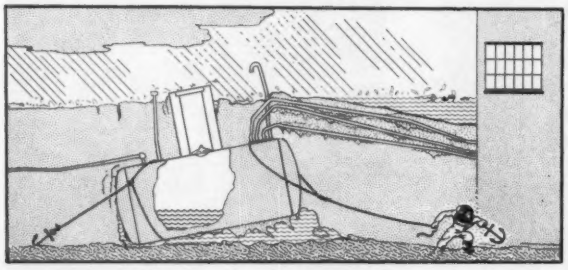
HAZARD

insulated cables

PRODUCT OF OKONITE RESEARCH

ARGUMENTS . . . *open forum for your opinions, ideas*

ALTHEA THORNTON, *Assistant Editor*



Will your buried oil tank float?

I take two exceptions to the diesel fuel-oil-storage suggestions, p 112-13, September POWER.

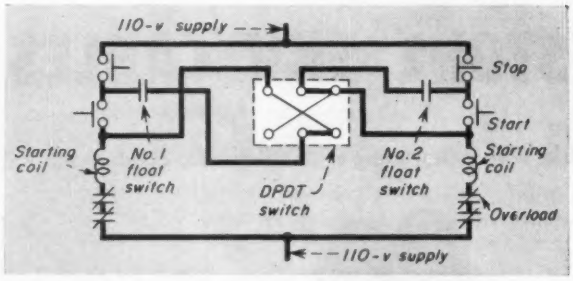
Unless the area has neither rain nor flooding possibilities, buried tanks should be held down by inverted U bolts fastened to a concrete pad. This should be heavy enough so tank won't break out and float if ground becomes flooded while it is empty or nearly so. I've seen this happen twice and it's mighty expensive to put tank back in place.

Oil-burning engines maintain considerable pressure—20 to 35 psi—on the suction header of their injection pump. What the pumps do not take is bypassed. There is also a drain for leakage that may accumulate quite a lot of fuel in a day's run.

This leakoff drain and the oil bypassed from the injection-pump suction header should be returned to the system *after* the meter so it does not go through it more than once.

S A HADLEY — *Kansas City, Mo.*

Your arguments are worth money. Send 'em in



WAH says this wiring is undesirable

Wiring diagram proposed by L Lightfoot in October "Plant Problems" (sketch above) is not very desirable.

Not only does this arrangement switch the float controls from one motor starter to the other, as Lightfoot mentions, but it also interchanges the STOP pushbuttons. This could lead to much confusion.

Less important but still undesirable, pump can be started with the START button regardless of float-control position. This can lead to difficulty unless it is intentional. In this case, switch should be the turn type, not a pushbutton that can be operated accidentally or unintentionally.

W A HIRSHFIELD — *Stamford, Conn.*

Best way to find steam-line plug?

Welding new piping to old without cutting an opening in the old header (related by H B Wayne in November POWER, p 129) reminds me of one time we were in Havana.

We wondered why a deck winch wouldn't work. Then we poured oil on the steam line, and it smoked up to a flanged connection. Beyond that point—no smoke!

Taking flange apart, we found the bolt holes were punched out, but not the pipe hole. That gasket had actually held the steam pressure.

Today, how many would think of using oil to trace a plugged steam line? I've seen sections of pipe taken apart to find which section was plugged. Nutz!

J M GORRIE — *Euclid, Ohio*

Let's eliminate plant fires

I like the fire-prevention rules on page 130, October POWER.

After looking at the chart of fire causes, I think fires could be practically eliminated by (1) good housekeeping and (2) proper installation and service. These results are attained through properly instructed, careful personnel.

CLYDE HOWARTER — *Canton, Ill.*

More on recharging dry cells

The suggestion to recharge dry cells (October "Arguments") comes up periodically. It has been tried and used for over 50 years in my experience. Results have not been too satisfactory. Output is good for short periods after charging, but capacity drops off rapidly.

One frequent shortcoming: zinc container ruptures at the seam. Another: too rapid charging may blow off the top.

I recommend using storage batteries. At least one manufacturer makes them in same dimensions as standard dry cells. For average service, one storage cell replaces two dry cells. My experience is mostly with cell groups using No. 6 batteries of the *Eveready* or equivalent type. But one manufacturer markets other sizes.

Life is indefinite, far exceeding dry-cell life. It depends, of course, on the care given to charging and servicing. Cost of the storage cells is not excessive.

C O VON DANNENBERG — *Brooklyn, N. Y.*

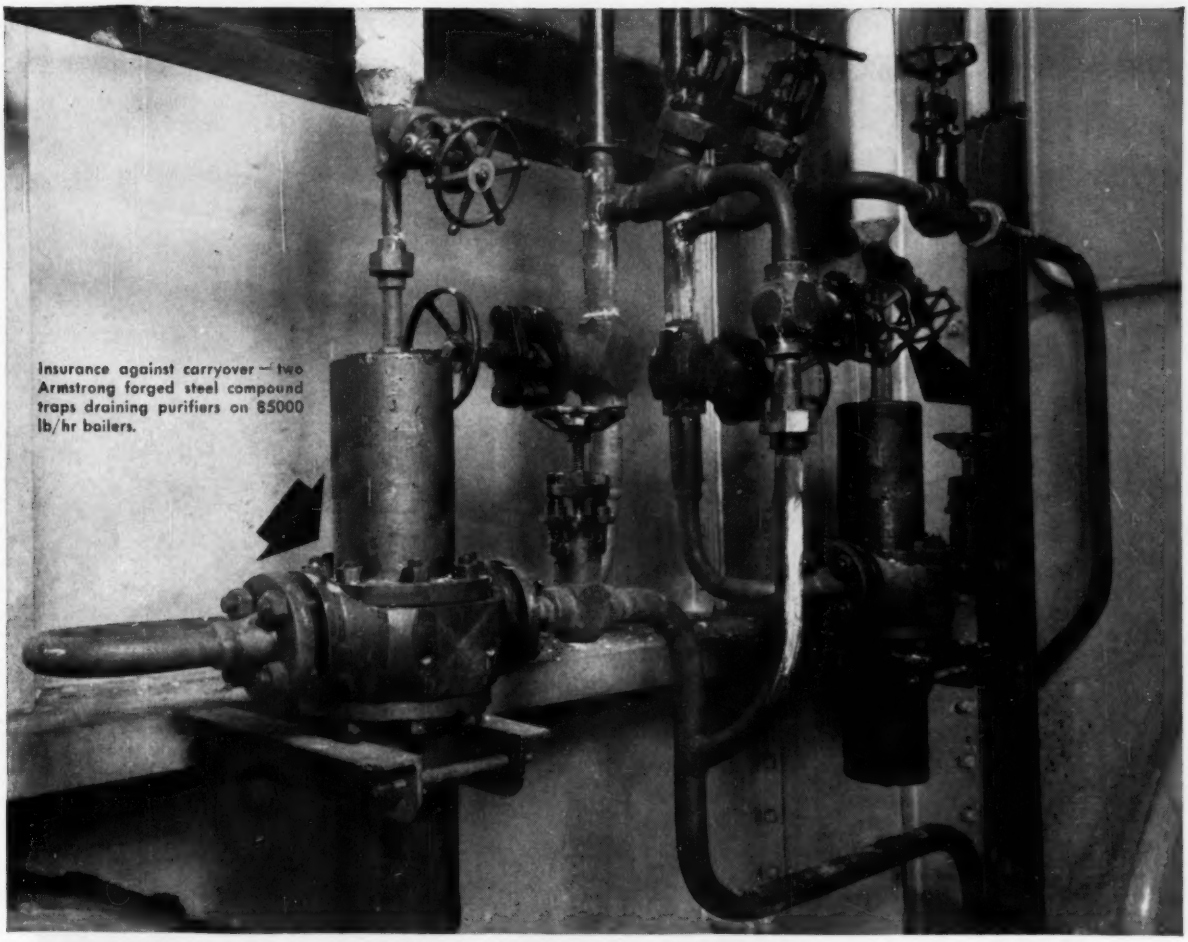
Ouch! We tripped

R L Smith of Pasadena, Md. points out an odd and interesting typographical error in December POWER.

News item on page 212 credits Thomas E Murray, member of the Atomic Energy Commission, with holding over 200 *patients.*

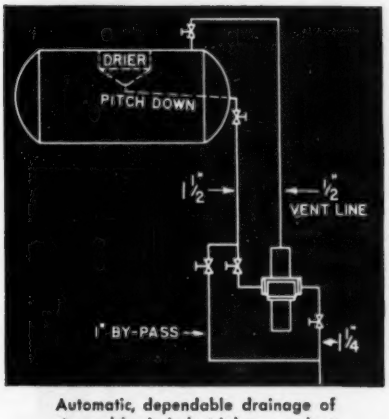
Says Smith, "This doctor should join the circus. It would be quite a feat, even with midgets."

Needless to say, item should have said Murray holds over 200 *patents.*



Insurance against carryover — two Armstrong forged steel compound traps draining purifiers on 85000 lb/hr boilers.

How to Insure Positive Drainage of Purifiers, Large Separators and Other Big Units . . .



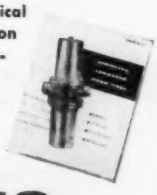
Automatic, dependable drainage of steam drier in industrial power plant with Armstrong compound steam trap.

● When you run up against a carryover or condensate load too large for ordinary traps to handle safely, Armstrong Compound Steam Traps are an ideal answer. They provide automatic, dependable drainage of loads up to 240,000 lbs/hr at 600 lbs. pressure. They have been thoroughly proved in service on purifiers, separators, driers, storage type hot water heaters, evaporators, vacuum pans and other large units.

Exceptionally high capacity in a relatively small trap is accomplished by a large piston-operated discharge valve controlled by a standard Armstrong inverted bucket trap mechanism. Cast semi-steel and forged steel models are available with 1", 2" and 3" pipe connections. Size, price, simplicity of mechanism, quality of materials and ease of installation are all in their favor.

ASK FOR BULLETIN 215

. . . contains complete physical data, prices and installation notes. Call your local Armstrong Representative or write: Armstrong Machine Works, 812 Maple St., Three Rivers, Michigan

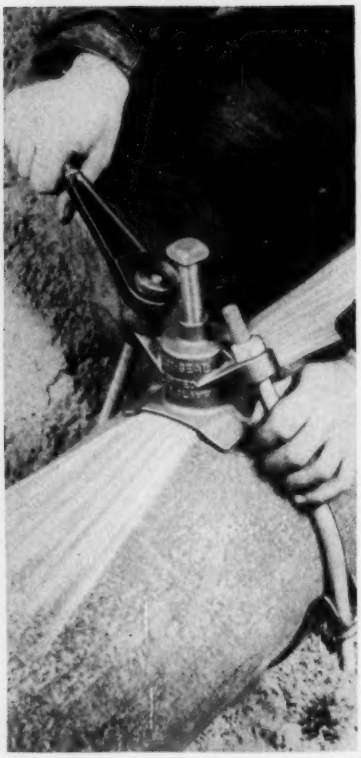


STEAM TRAPS FOR EVERY REQUIREMENT — APPLICATION ENGINEERED

ARMSTRONG STEAM TRAPS

1 Assemble clamp around leaking pipe. Have loose enough to slide over leak

2 Lift clamp and slide over leak. Be very careful if the fluid is toxic



3 Tighten nuts a turn at a time until cylinder's base is secure on the pipe

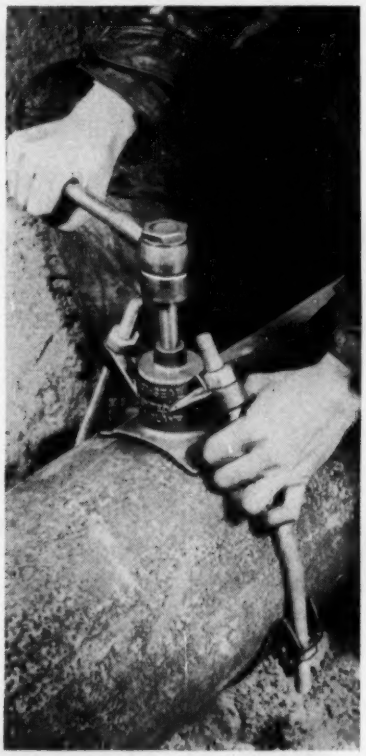
PRESSURE is tamed as clamp leakage brings it under control

HOW TO plug bad leaks

► NOW YOU CAN BRING costly and dangerous leaks under control with one of many clamps designed for this purpose. As photos show, head of clamp is iron cylinder. Its base has vents or ports on either side. Cylinder has rubber-faced metal piston that is screwed down against leak, same as the closing valve.

To prevent burning the gasket while shutting off leak, a brass band protects its lower rim. This also keeps rubber from being blown out through vents. Bottom of gasket is formed to fit pipe. Piston is keyed in cylinder so it doesn't turn while closing.

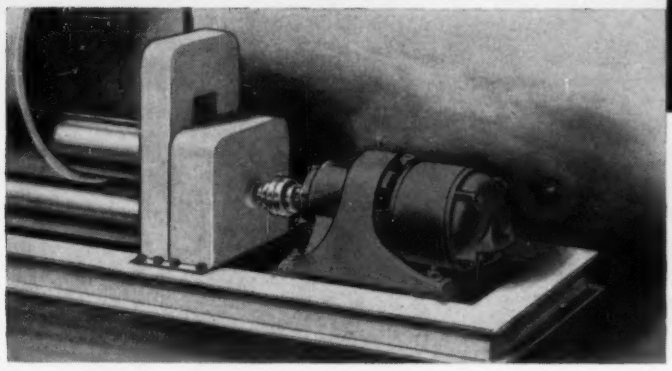
—Courtesy, M B Skinner Co, South Bend, Ind.

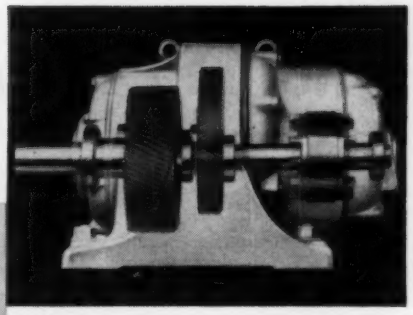


4 Tighten thrust screw until piston covers the leak and vents do not blow

Simplify WITH SYNCROGEAR

INTERNALLY GEARED POWER



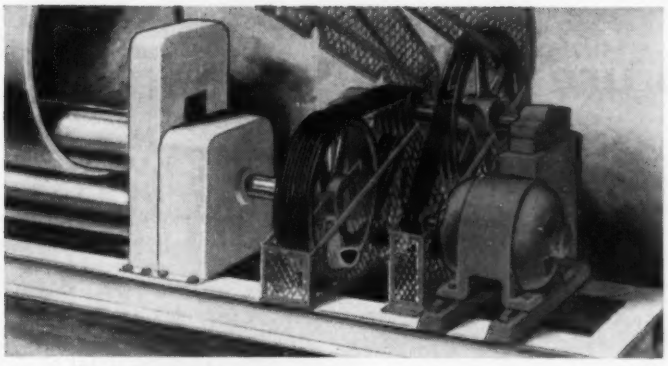


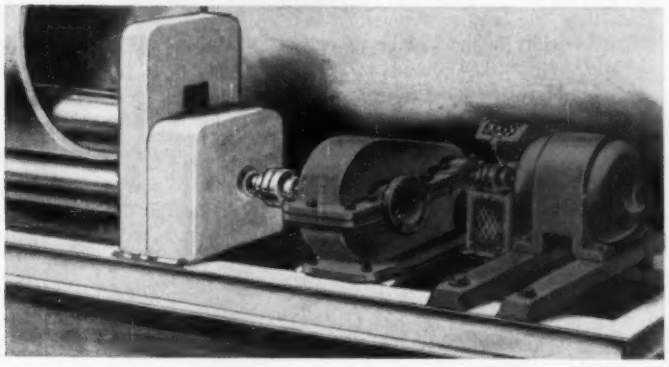
▲

U.S. SYNCROGEAR MOTOR

5 TO 10,000 RPM
½ TO 30 H.P.

Reject CUMBERSOME HOOKUPS





The U. S. Syncrogear is more than a motor. Its "packaged" assembly includes a high speed motor, an enclosed sealed gear-train, correctly engineered for the load, always in exact alignment, all mounted in a single case which saves space and eliminates the ungainly appearance of complicated hookups.

You don't have to calculate chain, sprocket, bearing or shaft requirements, or invest in separate mechanisms, special fabricated guards, extra pulleys and belting when you direct-connect a Syncrogear.

More and more manufacturers are using Syncrogears on their products to improve appearance and increase saleability.

Free—Mail coupon for all new descriptive multicolor booklet with all the facts you should know about geared motors.

U.S. *Electrical* MOTORS

U. S. ELECTRICAL MOTORS Inc. P-2
P. O. Box 2058, Los Angeles 54, Calif., or Milford, Conn.
Send Syncrogear Booklet

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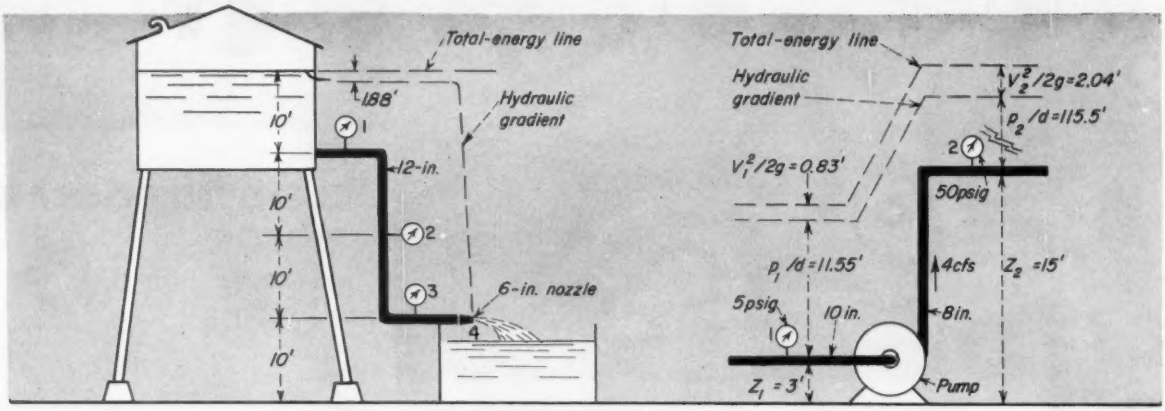
COMPANY_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

BASICS . . . *bringing engineering theory down to earth*

HOWARD KALLEN, *Associate Editor*



TE, HG LINES show how energy is distributed throughout the systems. Pump power, *right*, causes sudden jump in energy level. In using Bernoulli continuity formulas to solve flow problems we're neglecting friction so results are approximate

FLUID FACTS — 6

How to use energy formulas

► LAST MONTH we saw how continuity and Bernoulli formulas were developed, their advantages, limitations. Now let's put them to work.

In solving problems, remember that we're neglecting frictional effects. So answers are only a rough approximation. But the method throws light on basic principles. And results are often good enough for quick estimates.

Suppose we need to know water-flow rate from the elevated tank to the open vessel at ground level, drawing, top, at left. Also, velocity, pressure in 12-in. pipe and 6-in. nozzle. Symbols used have same meaning we gave them last month.

Since both tanks are open to atmosphere, air-pressure effect cancels out. Only pressure causing flow is due to elevation difference. First step: Draw total-energy (te), hydraulic-gradient (hg) lines (January Basics, p 146). Since water velocity in elevated tank is negligible compared to velocity in pipe, velocity head is virtually zero here. And te, hg lines are at same elevation as water surface.

Te line remains horizontal throughout the system (neglecting friction) since fluid energy stays constant. But hg line drops off. Reason: Some static-pressure head converts to velocity head.

Now let's pin down info we want. Pipe is open to the atmosphere at nozzle end so static pressure here is zero. Thus, hg drops to level of nozzle opening. Velocity head is the vertical difference between hg and te lines:

$V_4^2/2g = 30$ ft
$V_4 = 44$ fps

Applying continuity formula here:
$Q = A_4V_4 = [\pi(6/12)^2/4] \times 44$
$Q = 8.64$ cfs

Since flow rate is same throughout the system, velocity in the 12-inch pipe is:
$V_1 = Q/A_1 = 8.64 \div \pi(12/12)^2/4 = 11$ fps
Velocity head here is:
$V_1^2/2g = 11^2/64.4 = 1.88$ ft

Static-pressure head is equal to difference between pipe elevation and hg line. So it's easy to figure static pressure at points 1, 2 and 3.

$p_1/d = 10 - 1.88 = 8.12$ ft
$p_1 = 8.12 \times 62.4/144 = 3.52$ psi
$p_2/d = 20 - 1.88 = 18.12$ ft
$p_2 = 18.12 \times 62.4/144 = 7.86$ psi
$p_a/d = 30 - 1.88 = 28.12$ ft
$p_a = 28.12 \times 62.4/144 = 12.2$ psi

Bernoulli equation can also be used where pump adds energy or turbine removes energy from fluid. Fluid's energy gain due to pump shows up as a sudden jump in te line. Energy loss due to turbine appears as a sudden drop:

$p_1/d + V_1^2/2g + Z_1 + E_{pump} - E_{turbine} = p_2/d + V_2^2/2g + Z_2$

Let's apply the formula to a simple problem: How much horsepower must the pump supply, drawing top at right, to maintain pressure readings shown, at 4-cfs flow rate?

First convert gage readings to standard feet of water (at 62 F):

5 psig $\times$ 2.31 = 11.55 ft
50 psig $\times$ 2.31 = 115.5 ft

These figures set level of the hg line. To spot in te level we need to find velocity heads at pump inlet and discharge:

$V_1 = Q/A_1 = 4 \div \pi(10/12)^2/4 = 7.32$ fps

$V_1^2/2g = 7.32^2/64.4 = 0.83$ ft

$V_2 = Q/A_2 = 4 \div \pi(8/12)^2/4 = 11.47$ fps

$V_2^2/2g = 11.47^2/64.4 = 2.04$ ft

Adding these vertical distances to the hg level we locate the te line. Difference in the te-line elevation between pump inlet and discharge is equal to pump energy supplied to each pound of water:
$E_{pump} = 15 + 115.5 + 2.04 - 3 - 11.55 - .83$
$E_{pump} = 117.2$ ft or ftlb/lb
Hp = (4 cfs $\times$ 62.4 $\times$ 117.2) $\div$ 550
Hp = 53.2

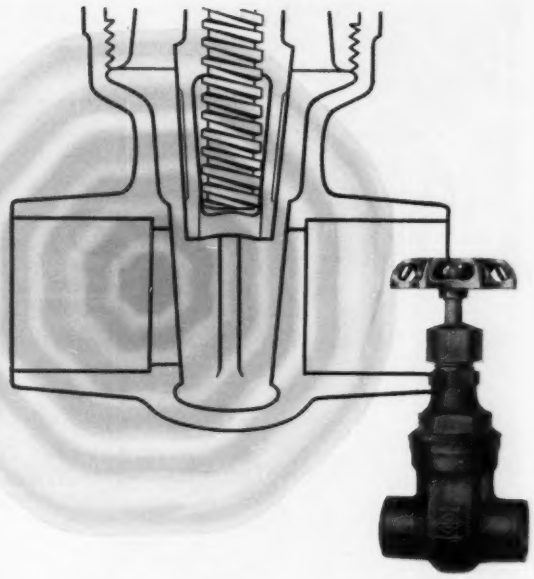
When the heat's on

you need the extra strength of

JENKINS

Solder and Socket End

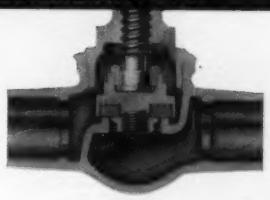
VALVES



Solder End GLOBES and ANGLES

300 lbs. O.W.G.
¼" to 3"

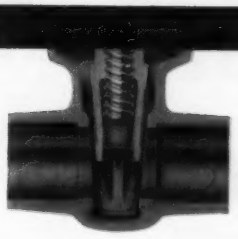
Fitted with Renewable Composition Disc.



Solder End GATES

225 lb. and 300 lb. O.W.G.
⅜" to 3"

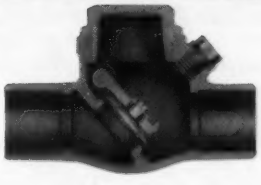
With solid or split wedges, and stationary or traveling spindles.



Solder End CHECKS

300 lbs. O.W.G.
¼" to 3"

Regrinding. May be easily reground without removal from line.



NEW BULLETIN Lists all Jenkins Solder End and Socket End Valves and gives complete instructions for soldering and brazing. Ask for Solder-Socket End booklet.

The "light-duty" look of copper tubing installations is deceiving. Valves must provide an accurate fit to tubing and *hold it* under the intense heat of soldering. And, because flexible tubing does not afford the rigid support of standard pipe, valves must withstand unusual strains in operation.

Jenkins Solder End Valves are engineered to meet these demands with strength to spare. High tensile bronze castings have liberal dimensions for extra rigidity. Smooth, clean bores assure accurate fit, easy soldering, positive seal to types K, L, and M Copper Tubing.

For faster, trouble-free installation, and lasting economy, specify Jenkins Solder End Valves. Jenkins Bros., 100 Park Ave., New York 17.

JENKINS Socket End Valves

for Class B or IPS Tubing

Jenkins bronze valves with socket ends for silver-brazing are made in Globe, Gate, and Swing Check patterns to control compressed air, hot oil, and similar fluids in tubing hookups where specifications call for permanent, leakproof joints. Complete information in the Bulletin offered below.

JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND

SINCE 1864 TRADE JENKINS MARK

Jenkins Bros.

SOLD THROUGH LEADING INDUSTRIAL DISTRIBUTORS

MARMY and his helper got down to work on the corliss engine while the boss's son, feet up on his desk, snored away

Marmy goes to pot

► YESTERDAY I started climbing the rickety old stairs to Marmaduke Surfaceblow's office above O'Houlihan's Machine Shop & Engine Works. But just then the machine shop's flapping leather belts slowed down and stopped. I backed down and looked into the shop. It was coffee time and the gang was gathering around the coffee pot in the shop's back end.

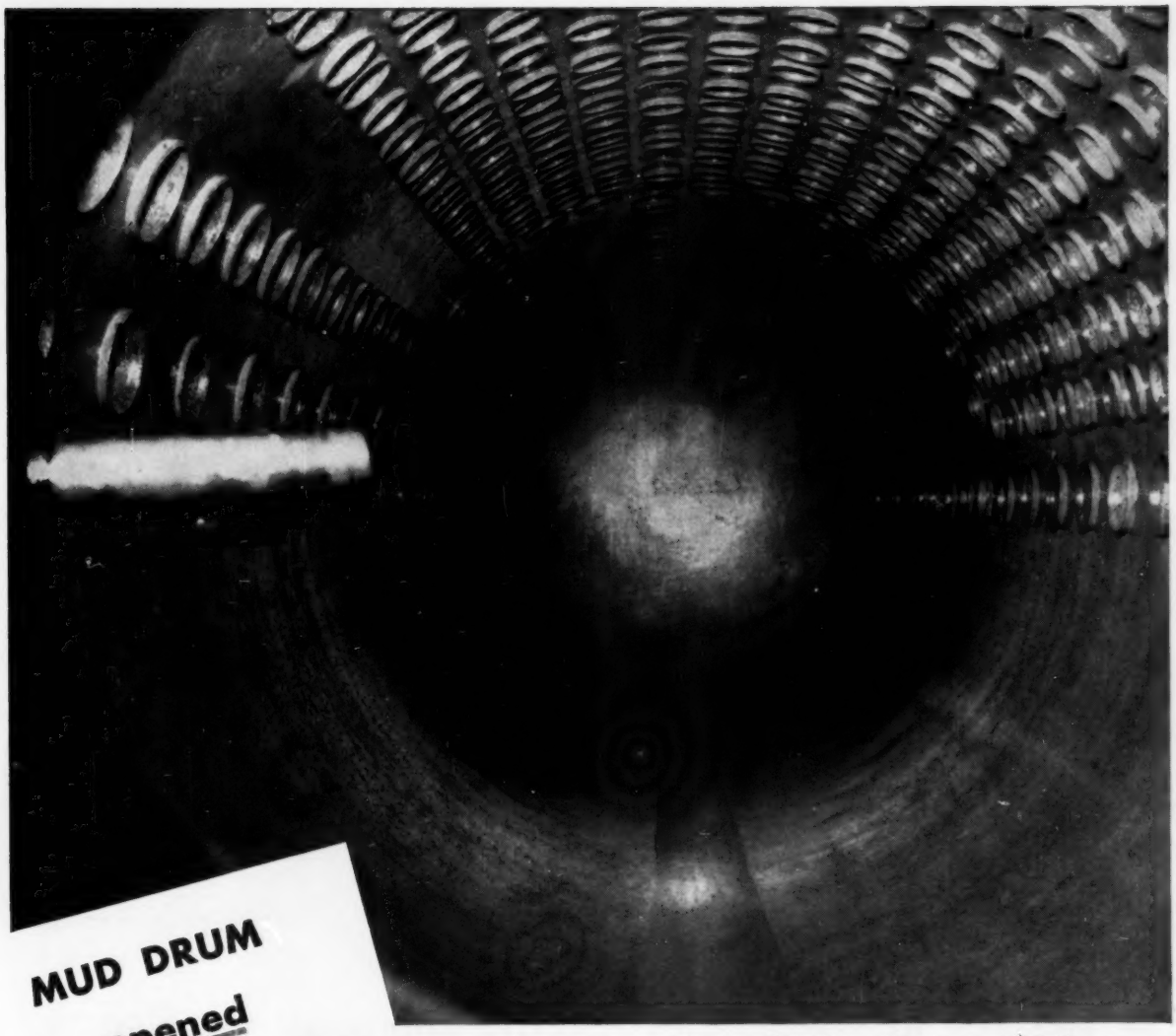
There was our hero Marmy, swilling coffee out of a big white cup in front of O'Houlihan's glass-enclosed office. Surrounding him were characters in greasy overalls, who looked like they came straight out of J R Williams' famous machine-shop cartoon. There was Grindstone Gus, Squirt-can Casey, George Mainbearing, Center-punch Louie, Chain-fall Tony, O'Houlihan and his draftsman T Square Fararri. Most of these old-timers had been ship's engineers and machinists—now happy to have a berth at this shore-side machine shop.

By the time I joined them, everyone seemed to be slurping, smoking and talking—everyone but the old consulting engineer. Marmy just puffed quietly on a piece of rope yarn and nursed his cup of rust remover—no doubt his amazing mind was whittling down some highly technical problem to size. His tall erect figure, the familiar checkered vest and that tough weather-beaten face under his gray bowler called for respect.

Here was a man who needn't take a back seat to anyone—down below in a ship's engine room, ashore in a power plant or in any of the many bars along the waterfronts of the world's great ports. For one thing, there are still too many crooked noses and missing teeth amongst seafarers, who disagreed with Marmy at one time or another while feeling a little gay, for him not to be respected.

When I got to the group, T Square put a cup in my hand and poured it full. O'Houlihan glanced at me, then said, "Ahoy, there." He then pointed to a large marine engine's bent piston rod on the bench and said casually through a mouthful of pipe smoke, "You'll have to make a new one, Grindstone, no use trying to straighten her. She looks like a pretzel." But before Grindstone could answer, Marmy came to life with one hell of a roar.

(*Continued on page* 202)



MUD DRUM
as opened
after one year
on line
with
THE *nalco* SYSTEM

Unretouched photo of Nalco treated boiler at Georgia Institute of Technology, Atlanta, Georgia

● Calling this a mud drum serves only to identify its location . . . it is perfectly clean after a full year on line. The unretouched photo was taken immediately after the drum was opened. No wash-out was necessary. Not only is the drum free of scale and corrosion . . . Nalco sludge conditioning operated so effectively that even under the static, off-line draining condition, no sludge deposited in tubes or drums.

The Nalco System can get results like these, economically, in *your* plant—regardless of boiler size or pressure. Write or phone Nalco today for action on a complete water treatment program.

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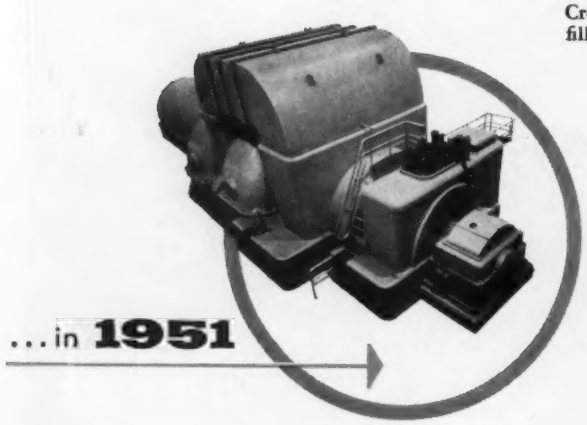
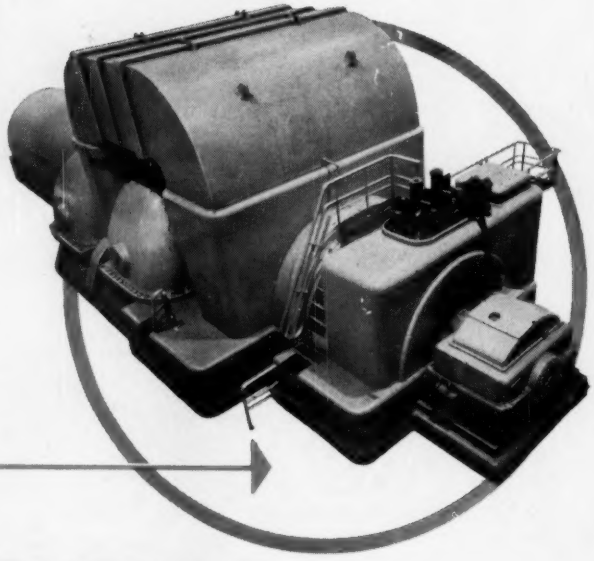
Telephone: POrtsmouth 7-7240
6222 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario

THE *nalco*® SYSTEM . . . Serving Industry through Practical Applied Science

Units No. 1 and No. 2 are 150,000 KW General Electric cross compound turbine generators. Unit No. 1 was installed in 1951, and unit No. 2 in 1953, at the Indiana and Michigan Electric Company's Tanners Creek Plant, Lawrenceburg, Indiana. Both lubricating systems were filled with 6500 gallons of Gulfcrest.



...in **1951**



...in **1953**

and again in **1955**

the Indiana and Michigan Electric Company selected

GULFCREST OIL

to provide long range turbine protection

Gulfcrest has an unmatched record of outstanding performance in every make and type of steam turbo-generator. There are two good reasons for its recognition as the world's finest turbine oil.

First, crudes are carefully selected for the best turbine oil properties, then put through the usual refinery steps for oils of this type. Next, the oil is Alchlor Processed—Gulf's exclusive super-refining step which removes the unstable hydrocarbons that form sludge, harmful acids, and accelerate oxidation. Special inhibitors are also added to increase oxidation stability, prevent foam and protect against corrosion.

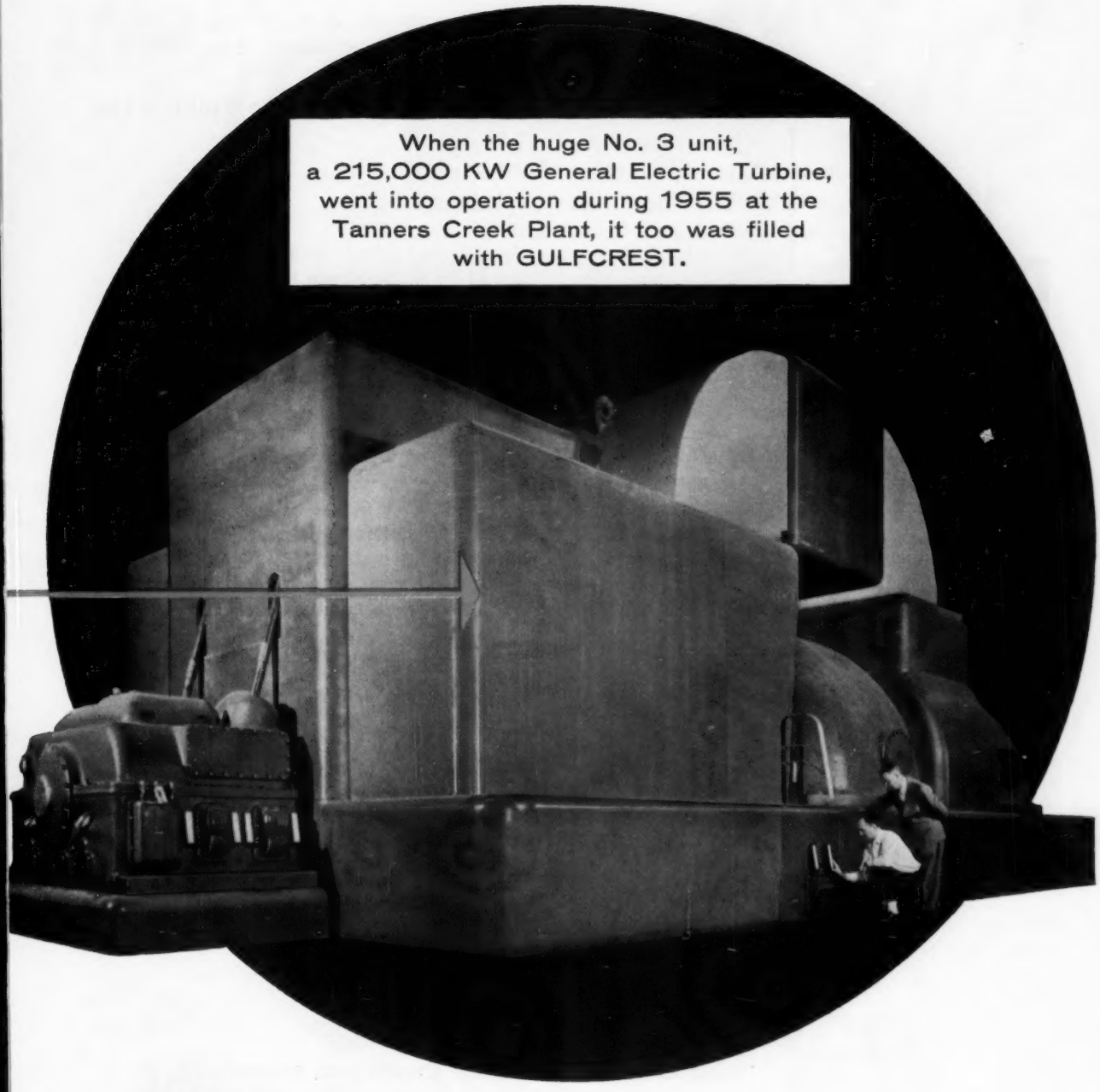
In several large turbines Gulfcrest has been in continuous service for over twenty years. The systems are still free from sludge or rust, and neutralization numbers of the oil remain remarkably low.

The next time you fill a turbine system specify Gulfcrest—and insure safe, long-lasting protection. Consult the telephone directory for the number of your nearest Gulf office and have a Gulf Sales Engineer recommend the right grade of this outstanding oil for your turbines.

Gulf Oil Corporation • Gulf Refining Company

1822 GULF BUILDING, PITTSBURGH 30, PA.

When the huge No. 3 unit,
a 215,000 KW General Electric Turbine,
went into operation during 1955 at the
Tanners Creek Plant, it too was filled
with GULFCREST.



GULF

THE FINEST PETROLEUM PRODUCTS FOR ALL YOUR NEEDS

Reader service section

Start with these quick samples . . .

Expansion - $105 million worth . . .

is what's planned for new power projects in Puerto Rico. First phase, already under way, will double power capacity at the Puerto Nuevo steam-electric station outside of San Juan.

Reports From the Field, p 154

Turbine failure explained . . .

The tragic failure of a low-pressure spindle in a Chicago central station may prove the last of its kind because this and other incidents have focused much attention on large forgings – material specifications, production and inspection. Read POWER'S digest – send for the complete report; 12 digests of other papers.

Technical Briefs, p 156

How does this stack up?

Precast chimney is claimed to combine low cost of steel stacks with the permanence and high draft of brick stacks. It's a feature of this month's equipment news. Full pages on pumps, valves, plus a wealth of other problem-solving developments, reported for your quick review.

Plant Equipment News, p 160

Penny for your thoughts . . .

and it'll only cost twice that in U.S. postage to get your choice of the 30-odd manufacturers' bulletins appearing in this month's listing. Indicate the ones you want, stamp and mail the handy post cards POWER provides – we'll do the rest.

Free Literature, p 169

New look for George . . .

Format has changed, but George Edwards posts the same words of wisdom on his monthly page. A thought-provoking visit from an old boiler-inspector friend makes interesting reading – points out many sound engineering tactics.

George Edwards, p 172

For other timely ideas, see following service pages ▶

Now — A Revolutionary NEW Steam Trap!

INSTALL IT — FORGET IT!

ACTUAL SIZE

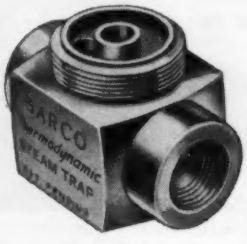
SO RUGGED **SO SIMPLE**

this steam trap practically eliminates maintenance

1. A CAP

2. A DISC

3. A BODY



That's all!

Major advance in trap design!

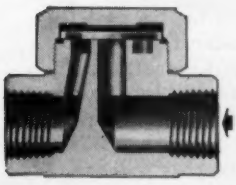
Imagine a steam trap machined from a solid block of stainless steel. A trap with only 3 parts...cap, disc and body...and not even a valve-closing mechanism — the kinetic energy of steam closes the valve and ONLY the TD uses this new operating principle.

That's the revolutionary new Sarco type TD. It has only one moving part...a hardened SOLID stainless steel disc. And it is not affected by superheat, water-hammer, corrosive condensate. That's why we can say INSTALL IT—FORGET IT!

Use the SAME trap for 10-600 psi...for light or heavy loads ...without seat or valve change or other adjustments. Closes tight on no load—no steam waste.

Ask for a 60 day trial installation of Sarco TD trap and strainer...write for bulletin 257. Sarco Company, Inc., Empire State Bldg., New York 1, N. Y.

2150-B



SIMPLICITY ITSELF! No valve-closing mechanisms to wear or stick. No critical clearances to choke. No gaskets to leak. Only moving part a SOLID stainless steel disc.

SARCO

Only Sarco Makes All 5 Types

That's why Sarco can give impartial advice on proper steam trap selection.

REPORTS FROM THE FIELD

What's happening in power and what it means to you

For Calendar of Events see page 234

Photo by Hamilton Wright

Puerto Rico starts power expansion program

► AN ELABORATE $105,000,000 power expansion project has been started by the Puerto Rico Water Resources Authority. When completed in 1961-62 the Authority's installations will be generating more than 1½-billion kwhr annually for industrial, residential needs.

First phase of the expansion will take place at the Puerto Nuevo steam-electric station outside of San Juan, photo above. New equipment is being added and expansion of facilities is under way involving some $16,000,000—doubling power capacity of the plant to 176,000 kw. The enlarged station is expected to be in full operation by the end of this year.

Puerto Nuevo is located on the San Juan harbor. It has its own docks, fuel storage system and other facilities and is linked with the system of power stations serving the Commonwealth.

Kyger Creek Plant goes into full operation

► THE FIFTH AND FINAL 215,000-kw steam turbine-generator at Ohio Valley Electric Corporation's Kyger Creek Plant—on the Ohio River at Cheshire, Ohio—has gone into operation, more than three months ahead of schedule. Some construction work and final details remain, however, to be completed. Having capacity of 1,075,000 kw, the station is the largest in Ohio and second largest power plant ever built anywhere by private enterprise.

Kyger Creek and Clifty Creek Plant —its sister station located at Madison, Ind., also on the Ohio River—were built by OVEC for the single purpose of supplying the tremendous electric power requirements of the U.S. Atomic Energy Commission's giant Portsmouth (Ohio) Project. Five 215,000-kw units are in operation at Clifty Creek. Operation of the sixth and last unit is scheduled for this month. It will give Clifty Creek a total capacity of 1,290,000 kw —making it the world's largest private power plant.

12th Annual Corrosion Conference to be held on March 12-16

► CORROSION PROBLEMS in industries and what is being done to solve them will be stressed in the technical program of the National Association of Corrosion Engineers 12th Annual Corrosion Conference. The meeting will be held concurrently with the 1956 Corrosion Show, March 12-16, at the Hotel Statler in New York City.

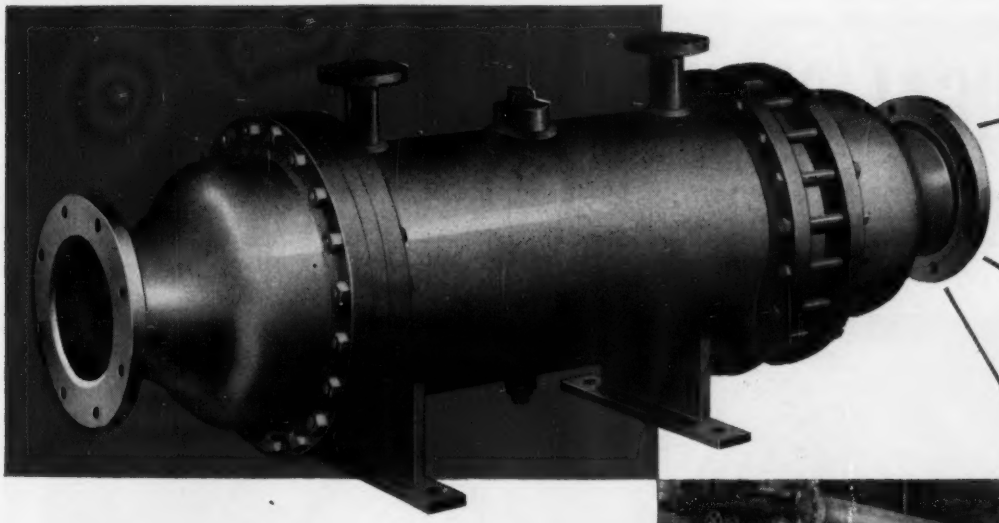
Technical papers on corrosion problems in the atomic industry will be prepared by Knolls Atomic Power Laboratory, Naval Research Laboratory, Argonne National Laboratory and the Aluminum Company of America. They will discuss corrosion of materials in high-purity water and methods of studying and controlling it.

Symposia and discussion groups will also be concerned with high-temperature corrosion, corrosion in the chemical and process industries, refinery and oil and gas production, pipeline corrosion, power and communication corrosion problems and general subjects.

J I Yellott named ass't director of Stanford Research Institute

► JOHN I YELLOTT, for the past ten years director of research for the Locomotive Development Committee of Bituminous Coal Research, Inc of New York, has been named an assistant director of Stanford Research Institute.

(*Continued on page* 232)



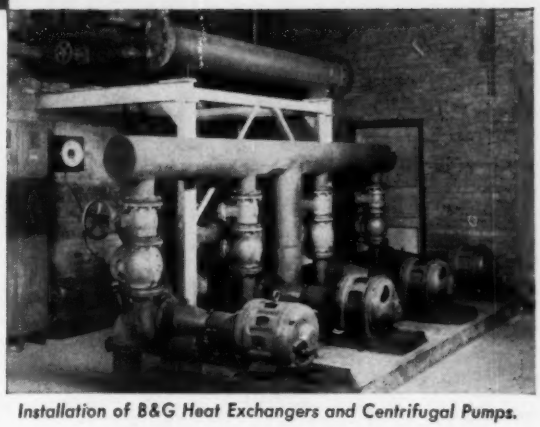
efficient design

special features

precision workmanship

correct selection and handling of materials

Why B & G Heat Exchangers give the service you expect



Installation of B&G Heat Exchangers and Centrifugal Pumps.

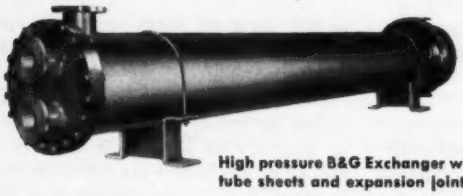
Whether you need an off-the-shelf or a custom-built unit, B&G offers quality and performance perfected in a quarter century of manufacturing heat exchange equipment.

Starting with proper selection and handling of materials, B&G Exchangers are built to designs of proved efficiency and with uncompromising workmanship. Ample material thicknesses in every detail and high tensile strength bolting are assurance of strength and long operating life. Full tube bundles and close tolerances between shell wall and baffles prevent slippage of fluid and assure maximum heat transfer. Units can be furnished with tubing of copper, steel, several of the stainless steels and other non-ferrous alloys.

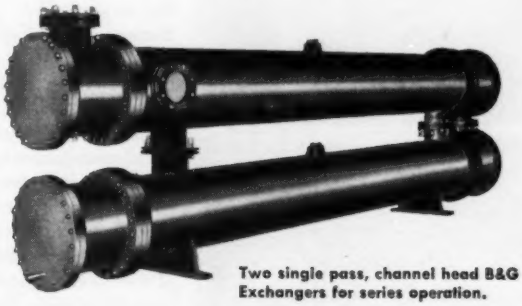
B&G Heat Exchangers are built to ASME Code U-69 requirements and can be certified by Hartford Steam Boiler and Inspection Service.

The B&G engineering staff is always available for consultation on your heat exchange problems. Send for catalog showing application range of B&G Heat Exchangers.

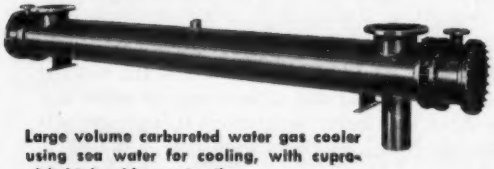
STANDARD DESIGNS OR ENGINEERED TO YOUR REQUIREMENTS



High pressure B&G Exchanger with fixed tube sheets and expansion joint design.



Two single pass, channel head B&G Exchangers for series operation.



Large volume carbureted water gas cooler using sea water for cooling, with cupro-nickel tube-side construction.

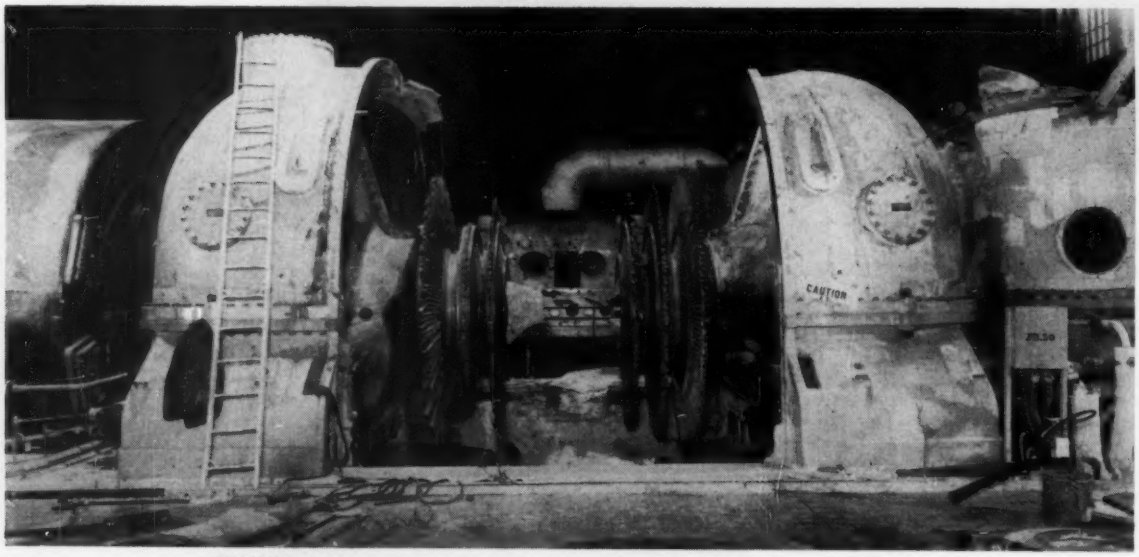
BELL & GOSSETT
COMPANY
Dept. EF-36, Morton Grove, Illinois

Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, West Toronto

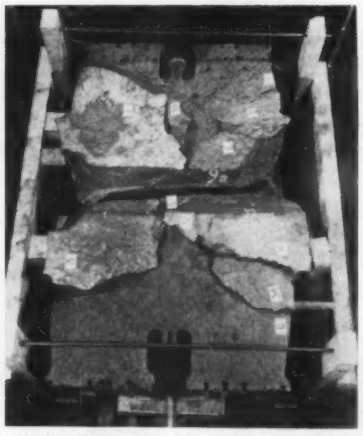
TECHNICAL BRIEFS

Latest engineering developments for busy power men

13 Papers for you on:
WATER TREATMENT
INSTRUMENTS
ELECTRICAL EQUIPMENT
BOILER FOULING



CLOSEUP of low-pressure turbine of Unit No. 4, Ridgeland Station, after accident



ASSEMBLY of spindle quadrants I and II

ASSEMBLY of 4 quarters at generator end

Turbine failure—metallurgy gives cause, cure

Investigation of large steam-turbine spindle failure. *By H D Emmert, Steam Turbine Dept, Allis-Chalmers Manufacturing Co.*

Shortly before midnight on December 19, 1954, the low-pressure turbine spindle of Unit No. 4 in the Ridgeland Station at Chicago of the Commonwealth Edison Co burst during a routine overspeed-trip test. Immediately following this tragic occurrence, a continuous and intensive investigation of its circumstances and cause was initiated and completed.

This paper was prepared to present the story of the investigation and analysis of the accident. Primary purpose of the investigation was to increase the knowledge of the steam-turbine industry so as to minimize the possibility of similar occurrences.

It is evident from this investigation that the Ridgeland low-pressure turbine failure is primarily centered around the metallurgy of large forgings. This and other incidents have focused much attention on material specifications and general procedures for producing and inspecting these large pieces of metal.

A sequence study of the failure indicates that it originated deep in the mass of the main body of the shaft. Metallurgical examinations confirm the fact that the metal was notch sensitive and susceptible to brittle failure. Various inspection techniques showed the presence of an overabundance of cracks in the form of flakes, providing the notches necessary to trigger a sudden and catastrophic failure of the shaft.

Only point of uncertainty is the means by which the shaft maintained its integrity as long as it did. It is probable that failure started when one or more of the numerous flakes in the main body near the bore extended slowly and approached the bore surface, a region of high local stress. At this instant, the brittle nature of the material caused this surface crack to widen into a major separation at an extremely high rate of propagation.

The influence of the material in preventing shaft failures is of primary

J-M 85% Magnesia is lightweight . . . easy for workmen to install half-sections on this 10" steam line. Insulation work at the Grace Chemical plant was performed by Young Sales Corporation of St. Louis. Engineering and construction was directed by Foster Wheeler Corporation of New York.

Your Btu's and dollars go further when you specify **Johns-Manville 85% Magnesia**

. . . the choice of insulation engineers at Grace Chemical's new Memphis plant

INDUSTRY'S LONG-TIME standard for temperatures to 600F is still your best insulation buy. For J-M 85% Magnesia provides high insulating value, easy application, long life, initial low cost and minimum maintenance. That's why insulation engineers consistently specify J-M 85% Magnesia for modern installations like Grace Chemical's new anhydrous ammonia-urea plant. That's why it will pay you to specify J-M 85% Magnesia for your new plant or modernization program.

To assure you maximum value from your insulation dollar, Johns-Manville gives you complete drawing-board-to-job-site service. You get expert recommendations by the world's most experienced insulation engineers . . . plus expert installation by authorized J-M Insulation Contractors. Write today for further information on J-M 85% Magnesia and Johns-Manville's unmatched facilities to solve your insulation problems. Address Johns-Manville Box 60, New York 16, N.Y. In Canada, Port Credit, Ontario.

J-M 85% Magnesia also comes in block form. Here you see it being applied to a vertical drum at a New Jersey petroleum refinery.

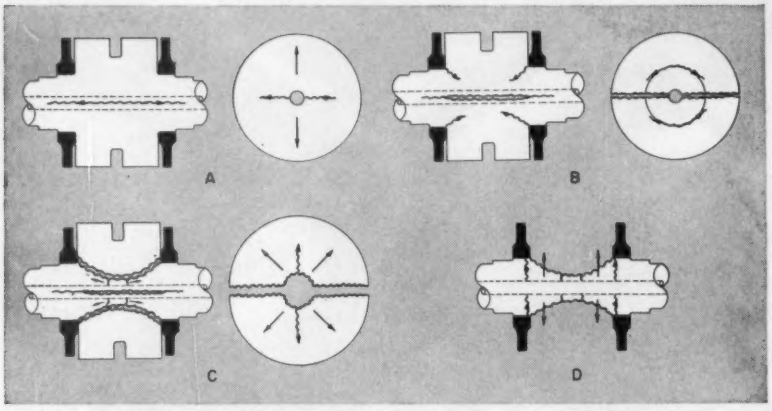
JOHNS-MANVILLE JM PRODUCTS

Johns-Manville *first-in* INSULATION

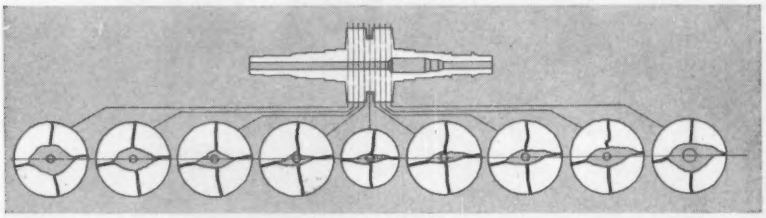
MATERIALS · ENGINEERING · APPLICATION

More TECHNICAL BRIEFS

Begins on page 156



PROBABLE SEQUENCE of failure established by examination of the spindle fragments



GENERAL PATTERN of shaft failure determined by many measurements of quadrants

importance. Susceptibility to brittle failure of the standard nickel-molybdenum-vanadium analysis in common use today is of great concern to the industry. Unfortunately, available alternate materials at the same strength levels offer little improvement. The most logical attack on the problem seems to be in a continuing study of factors influencing notch sensitivity.

An equally important factor in large-forging development is improvement of inspection methods. The Ridgeland forging was produced about four years ago, and in the intervening period much has been accomplished in this respect. As a matter of policy, all large turbine shafts are bored axially, since optical and magnetic-particle inspection of the bore surface gives a good indication of the general quality of the forging. However, some of the more dangerous types of discontinuities may lie away from the bore, undetectable by inspection.

Ultrasonic inspection has become the most important tool for the interior examination of metal masses. Intensive effort has been put into the development of improved sonic-inspection techniques. *ASME paper No. 55-A-172.*

Next month! More papers on forgings.

Water treatment

Status of demineralizing for treatment of boiler feedwater in today's power plants. *By V J Calise, Graver Water Conditioning Co.*

This paper presents briefly and simply some highlights, current trends and practices in design and application of ion-exchange demineralizers in today's industrial and central-station power plants.

Popularity of the demineralizer is indicated not only for application in the modern multipurpose high-pressure high-makeup steam power plant for production of low-cost byproduct power, but also in the fully condensing central station for low feedwater makeup. Difficulties in operation and some solutions are discussed in detail. *ASME paper No. 55-A-199.*

Selective silica carryover in steam. *By E E Coulter, E A Pirsh and E J Wagner, Jr, The Babcock & Wilcox Co.*

Studies of power-station operating problems have shown that troublesome turbine-blade deposits, composed principally of silica, are formed under certain conditions of boiler operation. The severity of the silica-deposit problem has been observed to increase with increasing silica concentration of the boiler water and increasing operating pressure. The work of a number of investigators has shown that silica carryover under such conditions is selective, the ratio of the amount of silica in the steam to that in the boiler water being greater than the corresponding ratios for other boiler water constituents. Such selective carryover is generally believed to be due to vaporization of silica from the boiler water into the steam.

Although the problem has been investigated widely, the previous data are not complete over the range of modern boiler operation, and often the data of several investigators fail to agree. Therefore, as the first logical step in searching for a solution of the selective silica carry-over problem, a test program to determine the distribution ratios of silica concentrations in steam to those in boiler water over a wide range of conditions was undertaken and has been completed.

The distribution ratios of the concentrations of silica in steam to those in boiler water were determined over a range of pressures from 300 to 3140 psi, of silica concentrations in the water from 12 to 1000 ppm, and of pH values of the water from 7.8 to 12.1. Mechanical carry-over, determined by using a radioactive tracer, was insufficient to necessitate corrections to the vaporous silica carry-over data at pressures above 500 psi. *ASME paper No. 55-5A-19.*

Instruments

Response of temperature - measuring elements to thermal transients. *By J A Clark, Massachusetts Institute of Technology.*

The requirements of modern automatic control and regulation demand increased speed of response from all measuring instruments. Not least among these various instruments are those which measure and record temperature—or some property whose change under certain specified and controlled conditions is related to temperature. During any temperature change—the transient period—it clearly is important to have accurate and timely information from those instruments sensing and controlling temperature.

It is the author's intent to review and

(*Continued on page 226*)

Directions for ordering papers on p 230

Hall Industrial Water Report

VOLUME 4 FEBRUARY 1956 NUMBER 1

New Plant or Expansion of Old One

How well you engineer your plant services may determine whether you get continuous production or operation like a paralytic centipede. Water for steam generation, for cooling, for use in process—and water leaving the new plant—*can* be designed to be the least of your troubles. But the best time to listen to someone who knows how to make water behave is while you are still in the planning stage.

It's Cold Out There!

Frequent subzero weather with temperatures as low as −45 at the site of a proposed new plant in Minnesota was an important factor in the choice of a heating system by a large mining company planning to process iron from taconite. Space heating constituted about ninety percent of the load. Buildings to be heated were widely scattered over a large area.

When a high-pressure hot-water heating system was decided upon, water treatment had to be considered from two angles: protection of the boilers and protection of the heating system. Hall Laboratories was invited to study the raw water available and to recommend treatment.

Water could be obtained from either of two intakes from the surface supply; samples from both were analyzed. The types of metal used in construction of the heating system were determined, zeolite softening and deaeration of makeup, chemical conditioning and proportional chemical feeding facilities were thoroughly discussed in a survey report by Jack Summerville, Hall staff engineer. After completion of the survey report, it was learned that well water might have to be used temporarily because of delay in completion of the surface supply pipe line. Because the well water does not have as desirable a composition as the surface water, Hall urged that the pipe line be completed as quickly as possible and recommended that the well water be zeolite softened even though regenerations would be much more frequent.

The boilers have now been boiled out and, on Hall's recommendation, acid cleaned to insure thorough cleanliness of the heater surfaces. The plant is beginning operation.

Faith Justified By Performance

When an Eastern paper specialty manufacturer decided to build a new plant in California, the chief engineer wrote: "In dealing with the problem of water supply, water treatment, and so forth, we felt it desirable to call in Hall Laboratories, not only because of the past relations which have existed for so many years, but because we intend to retain Hall Laboratories as consultants for our California plant."

To start the survey, Hutcheson Page, of Hall's New York office, conferred with the plant management about the purchase of their boiler. After extensive checking of specific requirements, a factory-assembled, water-tube boiler was ordered.

Hall Laboratories already had experience with the water in the chosen locality in California. This provided a sound basis for recommending the proper pretreating equipment.

Because of the potential cost of water supplied from a city aqueduct, the plant wished to use water from its own wells. Hall recommended pretreatment equipment flexible enough so that it could properly prepare any of the various waters available for future use in any standard type of boiler operating at 250 psi. A salt regenerated cation-anion exchange system was suggested and accepted.

The plant also has followed other recommendations made by Hall for internal boiler-water treatment as well as treatment of steam by Hagamin.® A recent service report from Hall field engineer Orville Morrow states that the plant is maintaining very good treatment control.

South of the Border

Hall Laboratories pursues the "Good Neighbor" policy by helping many clients in South America and the West Indies on a consulting as well as on a continuing service basis.

A client in Maracaibo planned to install an additional boiler plant adjacent to the one already serviced by Hall Laboratories. Hall helped the plant select evaporator feedwater pretreating equipment, chemical feed pumps, pH meters, and helped plan the laboratory layout prior to start-up. Then Jack Summerville of the Hall headquarters staff made a trip to Maracaibo to help start operations, with special attention to their hot lime-gypsum reactor, pressure filters, hot zeolite softener, evaporators, and the treatment of their feedwater-condensate and boiler-water systems.

Continuing satisfactory conditions have been maintained by correspondence between the plant and Pittsburgh headquarters, supplemented by an annual consulting trip by Hall staff engineer, Alex Henricks.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

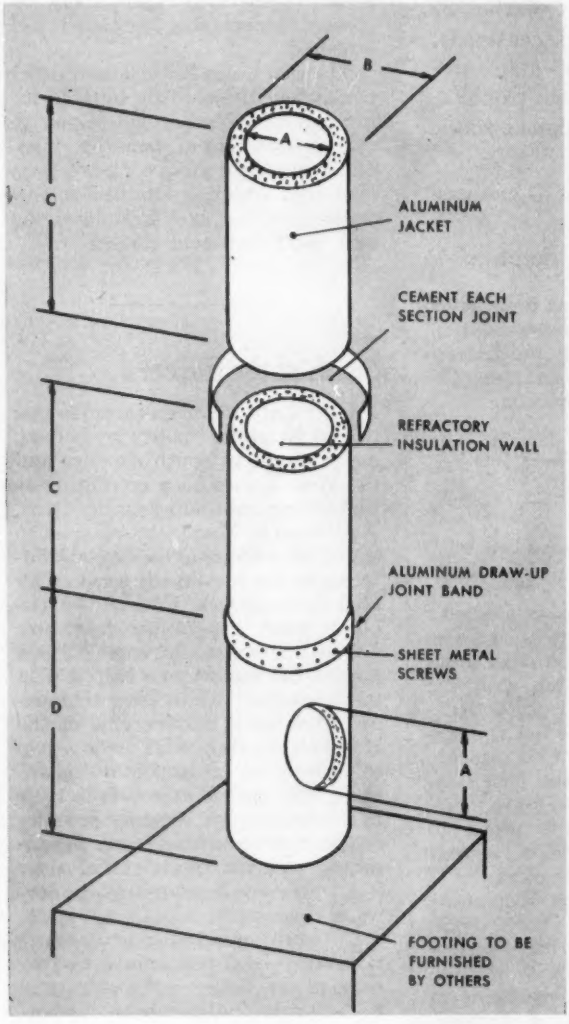
Water is your industry's most important raw material. Use it wisely.

Hall Laboratories, Inc.—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers



Precast insulated refractory stack

201 • Precast masonry stack is claimed to combine the low cost of a steel stack with the permanence and high draft of a brick stack. It handles flue gases from coal, oil or gas fuels and can be used in connection with boilers, furnaces, ovens, retorts and incinerators.

The stack is assembled of 3-ft sections, available in six sizes from 10 to 24-in. ID. Two types of sections are made: (1) *Standard*, for service where flue gas temperatures do not exceed 800 F based on continuous exposure and (2) *Hi-Temp*, for applications with flue gas temperatures up to 1600 F based on continuous exposure.

Outer jacket of the unit is of 0.020-in. sheet aluminum which requires no painting or maintenance. Joints are sealed permanently with an acid-proof, high-temperature cement, furnished with each section.

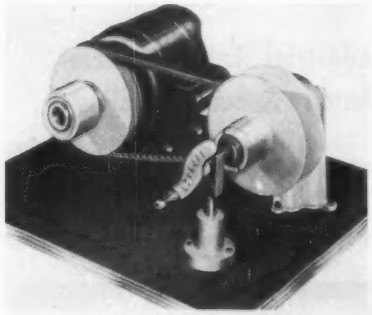
The stack can be installed as either an inside or outside chimney. When installed inside, a clearance to adjoining combustibles equal to one-third the inside diameter for *Standard* sections or one-half the inside diameter for *Hi-Temp* sections must be provided. For outside installations, the assembly permits 2½ sections free standing above the uppermost lateral support. This arrangement is said to be able to withstand 100-mph winds. Lateral stability is accomplished with pipe or angle guys or cable guys. Full details on request.

Van-Packer Corporation, Bettendorf, Iowa

DIMENSIONS AND WEIGHTS

Inside Diameter	10"	12"	15"	18"	21"	24"	A
Outside Diameter	14"	16½"	19½"	23"	26½"	30"	B
Section Length	36"	36"	36"	36"	36"	36"	C
"T" Section Length	36"	36"	36"	48"	48"	48"	D
Weight per Foot	37 lbs.	40 lbs.	70 lbs.	90 lbs.	100 lbs.	125 lbs.	
Added Weight of Crating per Foot	3 lbs.	3 lbs.	10 lbs.	12 lbs.	15 lbs.	17 lbs.	

For more data on these items, use post cards page 169. Identify your request with item number.

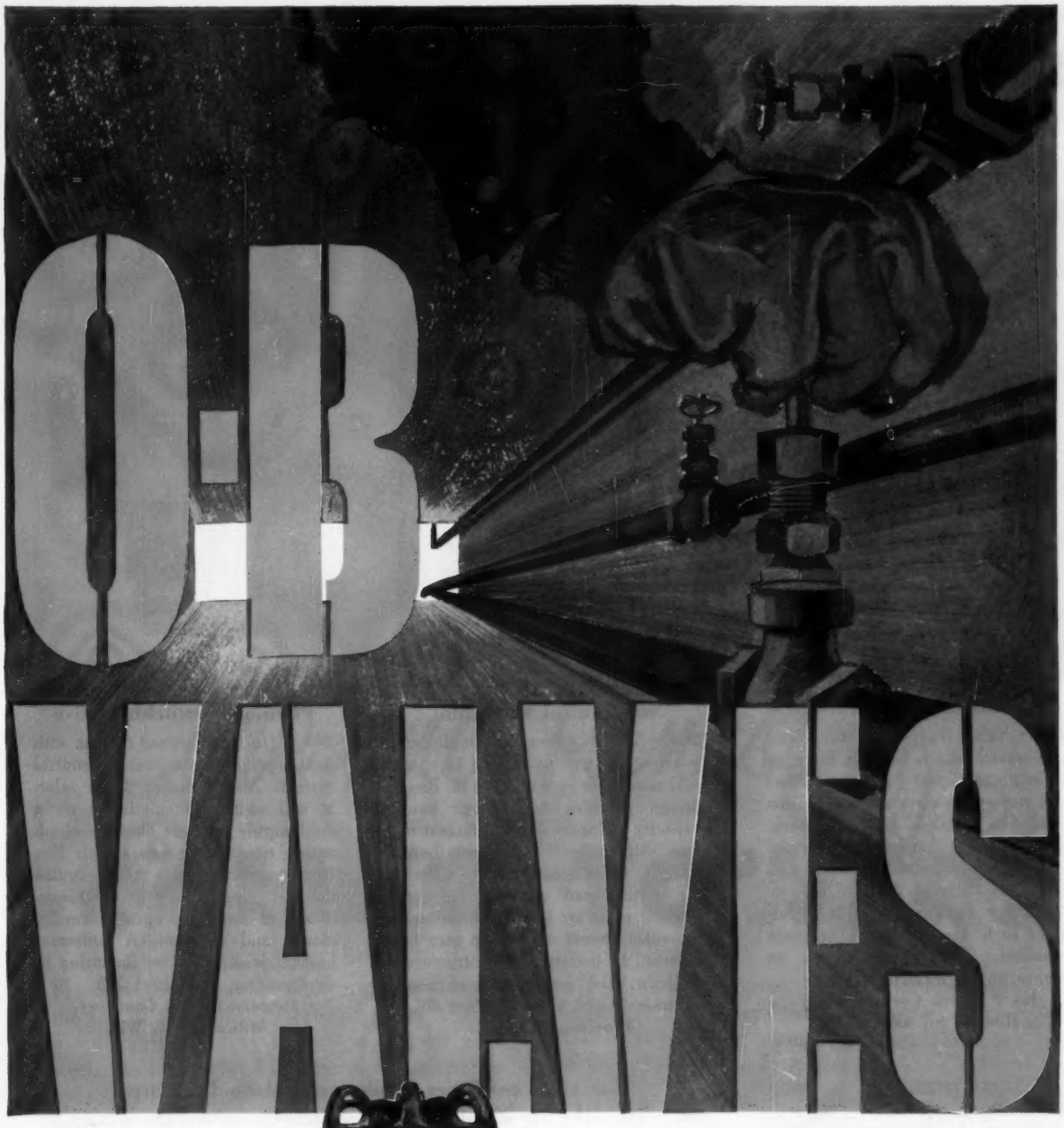


Variable-speed pulley

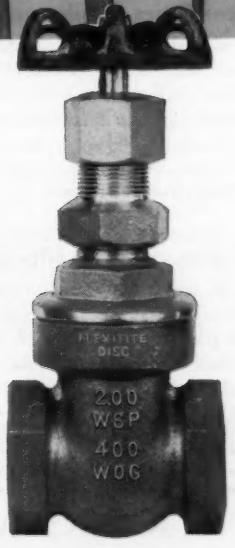
202 • This compound drive variable-speed pulley is claimed to maintain constant belt alignment through its entire speed range to 8 to 1 ratio. Using an 1750-rpm motor a speed range of 5550 to 690 is obtained at a rated ¾ hp. With an 1150-rpm motor a speed range of 3650 to 454 is provided at a rated ½ hp. Unit accommodates new NEMA motor frame shaft sizes and uses a ⅞-in. top width or "A" belt as standard. Available in either spring-loaded or manually-operated design they can be mounted on one side or alternate sides in accordance with installation requirements. Manually-operated units are equipped with either pedestal stand or attachment for hydraulic yoke.

Lovejoy Flexible Coupling Co, 4870 W Lake St, Chicago 44, Illinois

For news of six valve developments, turn page ►



Made for the tough spots . . .



O-B bronze valves are built for severe service by a manufacturer who has been making quality bronze valves since 1888. If you're having valve troubles, why not try O-B valves? Ask your distributor about them.

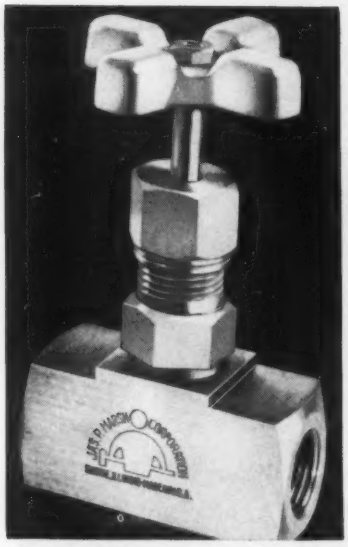
OHIO BRASS MANSFIELD, OHIO, U. S. A.

4616-V

More EQUIPMENT NEWS

Begins on page 160

Six valves designed to meet varied power requirements

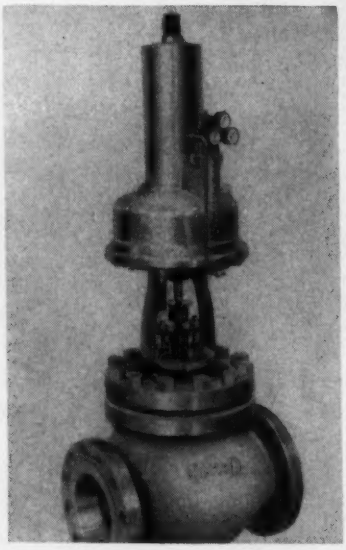


Stainless needle valve

203 • Valve is designed for corrosive service and is suitable for pressures up to 10,000 psi. Valve bodies and stem guides are machined from solid 416 stainless steel bar stock. Valve stem is hardened 416 stainless steel precision machined with fine pitch threads.

Marpak packing used is tailormade to fit the deep packing space provided. Further information on request to the manufacturer.

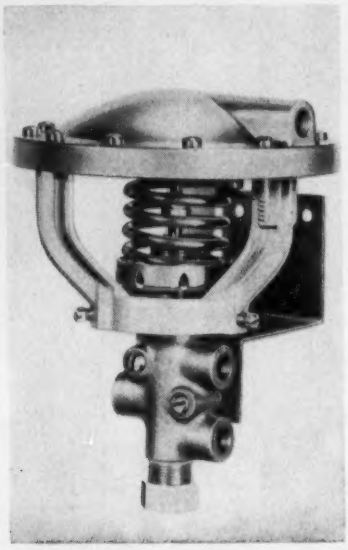
Jas P Marsh Corp, 3501 W Howard St, Skokie, Ill.



New control valve line

204 • *S-3000* valves of single-seat construction will be offered in nominal sizes from ½ through 8 in. Body design provides extra large bowl capacity to insure high coefficient of flow without involving excess body weight, manufacturer states. Need for a blindhead is eliminated—all internal parts are removable through the valve bonnet and action may be reversed by inverting superstructure. Bulletin 101-C available on request.

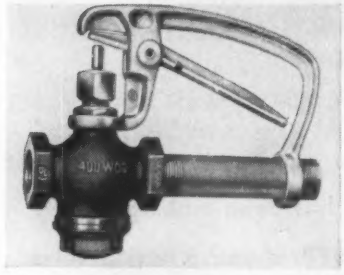
Hammel-Dahl Co, 175 Post Rd, Providence 5, R. I.



Pneumatic switching valve

205 • Unit is designed for use with dual-pressure pneumatic control systems. An exhausting 3-way valve, it will switch automatically on a dual supply pressure change—eliminating need for a separate air line from a central station to accomplish the switching. Three pipe connections are normally open, normally closed and common. A universal bracket is supplied for mounting in any position. Bulletin V-132.

Johnson Service Company, Milwaukee 1, Wis.



Bronze globe valves

206 • Lever-operated valve is designed for liquefied petroleum gas service. Safety feature reduces chance of burns when lpg is being transferred from tank to tank. Recommended for use on pressures to 400-lb gas, oil or water. Also made in conventional globe design.

Ohio Brass Co, Mansfield, Ohio

Gas valve combines diaphragm, solenoid features

207 • This valve has a sealed, oil-filled powerhead that contains a magnetic operator to provide motivating force. Special oil of controlled viscosity dampens plunger stroke in manner similiar to a hydraulic shock absorber.

Valve requires no bleed lines or bleed burners such as are needed with diaphragm-type valves—nor is it necessary to provide a terminal strip as with conventional solenoid valves. Request full details from manufacturer.

Minneapolis-Honeywell Regulator Co, Philadelphia 44, Pa.

Redesigned gate valve has slip-on disk stem feature

208 • Redesigned 125-lb rising-stem gate valves are recommended for general service on steam, water, oil or gas lines. Cylindrical design of body neck is said to offer maximum strength—eliminating need for massive wall sections. Sizes ½ through 3 in. have double-wedge-type disks; sizes ¼ and ⅜ in. have solid-wedge disks. Full details available on request to the manufacturer.

Crane Company, 836 S Michigan Ave, Chicago 5, Ill.

For more data on these items use post cards on p 169. Identify your request with item number.

For info on "pushbutton" air cooling, turn page ►

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COOLING TOWERS

From the first breath of air that passes through the fan of your Marley cooling tower, there's a specialist standing by to see that all goes well. He's a Marley Field Service Engineer—a factory-trained specialist with a most comprehensive knowledge of construction, operation and maintenance.

A Marley Field Service Engineer is on the scene whenever a new Marley cooling tower is started up. He "checks its pulse" . . . takes its temperature . . . sees that every vital component is functioning properly. At regular intervals, he will call back to give the tower a periodic check-up and to give you professional assistance on tower operation and maintenance. And of course, Marley Field Service Engineers are always available for consultation on any cooling tower problem, regardless of the type or make of tower.

This continuous close contact insures the continuance of "like-new" performance of your cooling tower. Like Marley design, engineering and research, Marley's Field Engineering Service exists for the sole purpose of providing you the most efficient and economical water cooling possible. For information, or for technical brochures on the care of cooling towers, write today or call your nearest Marley Sales Engineering Office.

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Kansas City, Missouri

More EQUIPMENT NEWS

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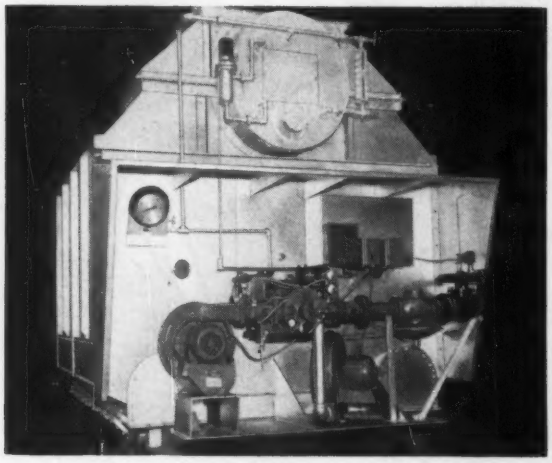
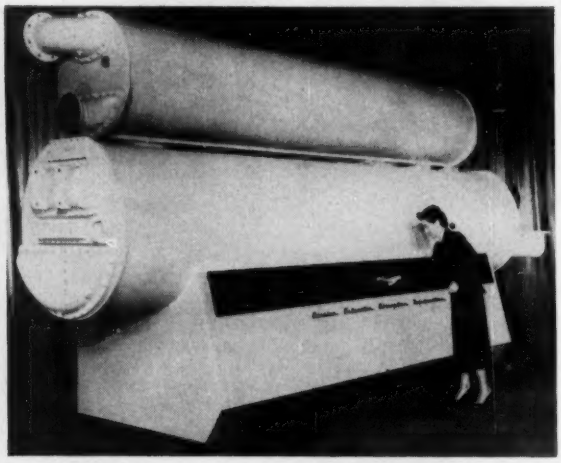


Packaged vaporizers for process heating needs

209 • *Type MH* vaporizers are designed for use with *Dowtherm A or E, Para-Cymene* or *Anisole* to provide accurately controlled temperatures over a broad range. Ready for indoor or outdoor installation, the three-drum units meet needs from 3,700,000 to 15,000,000 Btu/hr. They are furnished for heating with oil, gas, waste heat or special fuels and operate with a slight positive pressure in the furnace. Need for an induced draft fan is eliminated and stack height is materially reduced, manufacturer states.

Divided tube banks enclose the furnace. Straight-through gas flow over tube banks requires furnace baffles only. Full data in bulletin DV, obtainable from manufacturer.

Union Iron Works, Erie, Pennsylvania



"Pushbutton" absorption refrigerating machines

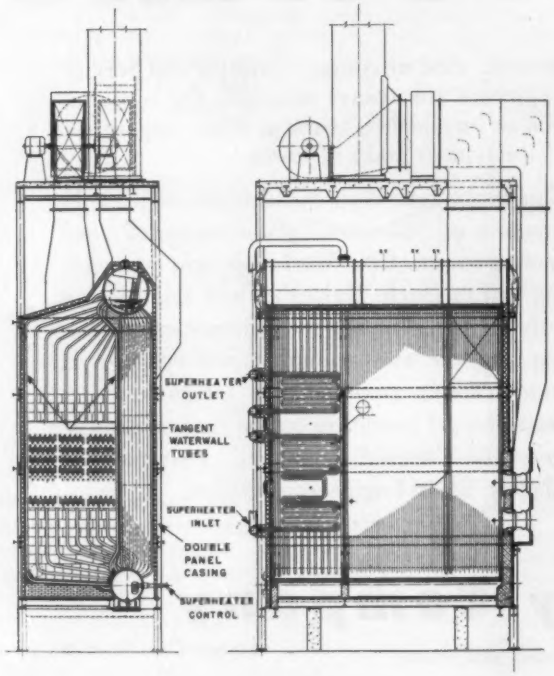
210 • Units produce chilled water from steam; are available in sizes from 100 to 700 tons. Machines have no major moving parts and employ plain water as the refrigerant.

Manufacturer states that these units will make skyscraper air-conditioning installations as easy to operate as a home-heating unit. They can be controlled by a time clock, thermostat or pushbutton. Units adjust automatically from full capacity down to zero load, and back to full load, with little loss in efficiency. There is nothing about the unit that can be damaged by overloading.

Many major service lines and all external auxiliary piping normally assembled on the job site are eliminated.

Carrier Corporation, Syracuse 1, New York

For more data on these items, use post cards page 169. Identify your request with item number.



Field-erected headerless-type steam generators

211 • Units of capacities ranging from 50,000 to 150,000-lb of steam per hour can be built for either pressurized or balanced-draft firing. Heat recovery for higher efficiencies and superheat equipment can be provided as desired.

Superheater headers and steam temperature control lines are on outside of unit for ready access and are drainable.

Design consists of a two-drum bottom-supported boiler with completely water-cooled furnace. Furnace has tangent tube spacing on bottom, both sides and roof and a wider tube spacing in front wall to permit burner installation with a tile backed-up target wall opposite burners. This target wall is tube cooled with wall tube spacing arranged to form a furnace screen ahead of the superheater. Water-steam friction losses are reduced to less than ¼ of that of conventional designs, according to manufacturer. Thus, virtually all of hydrostatic head is available to support rapid circulation through tubes.

Installations are completely self-draining, including boiler, waterwall, economizer and superheater tubes. Units can be provided with steam temperature control of either submerged heat exchanger type or spray type. Unit is bottom supported —thus all structural members have low unit stresses.

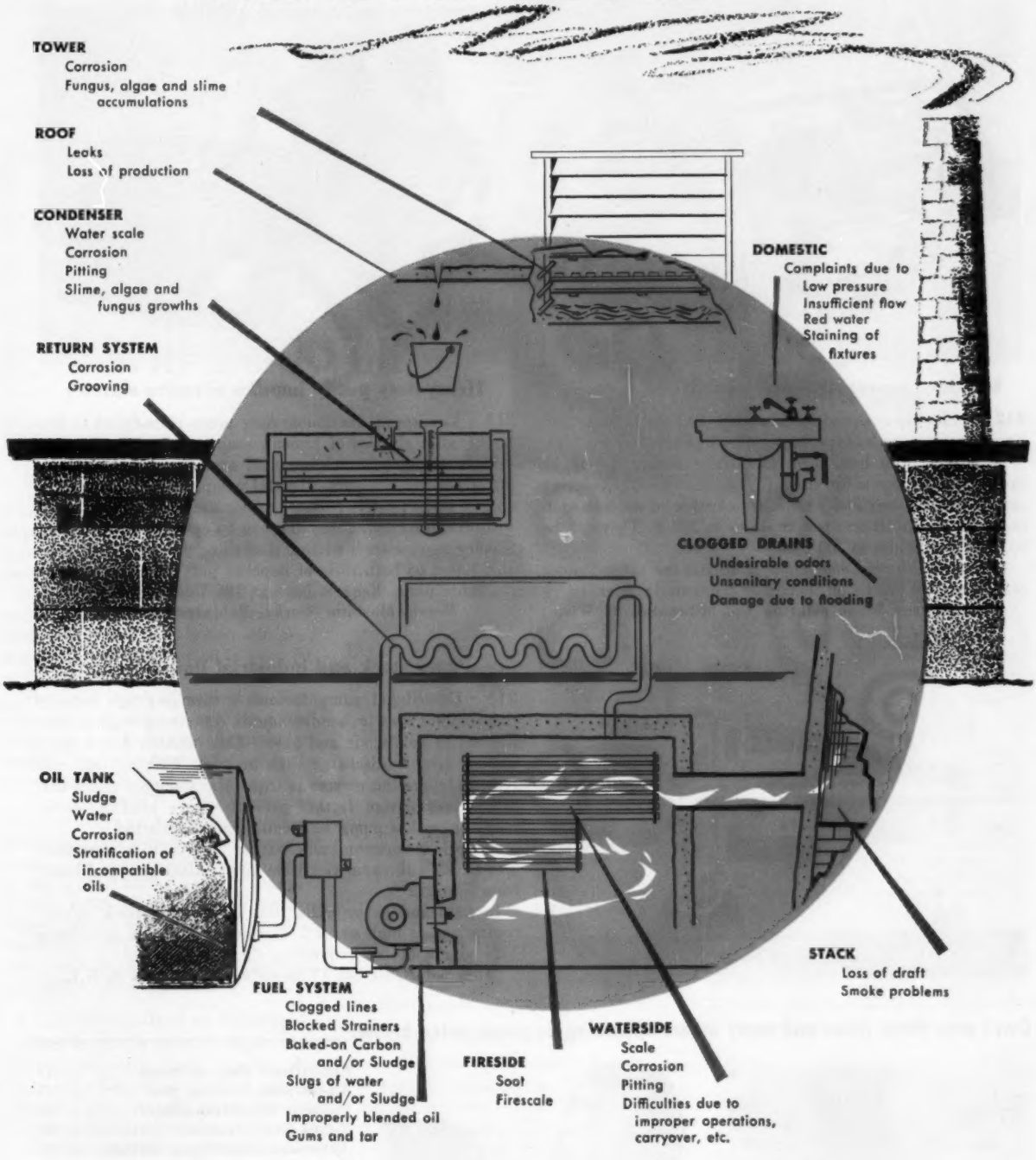
Springfield Boiler Co, Springfield, Ill.

For news of recent pump developments, turn page ►

ALKEN-MURRAY CORPORATION

ESTABLISHED 1934

First to: *DIAGNOSE, PRESCRIBE AND GUARANTEE RESULTS FOR ALMOST ANY PROBLEM DUE TO ANY TYPE FUEL OR WATER*



LET US HELP YOU WITH YOUR PROBLEM

WRITE TO ALKEN-MURRAY CORPORATION, DEPT. P-1
131 EAST 23RD STREET • NEW YORK 10, N. Y.

More EQUIPMENT NEWS

Begins on page 160

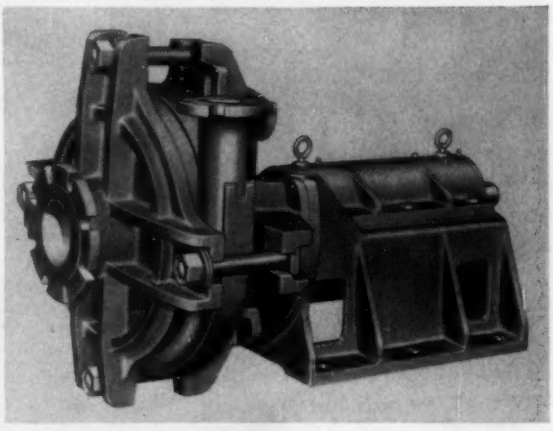
Three products to help solve your industrial pumping problems

Leakless general-purpose centrifugal pumps

212 • Units are designed for handling precious or hazardous liquids where no leakage is permitted. They are available in a fractional-hp line, *C-10,* to include motors through 2 hp, and an integral-hp line, *C-11A* and *C-11B,* covering motors above 2 hp. The pumps are capable of accommodating heads to 250 ft and temperatures to 250 F. They can be had with capacities to 500 gpm.

Called the *Electri-Cand* pump, it utilizes the canned-motor principle. Full details on request to the manufacturer.

Allis-Chalmers Manufacturing Co, Milwaukee 1, Wis.

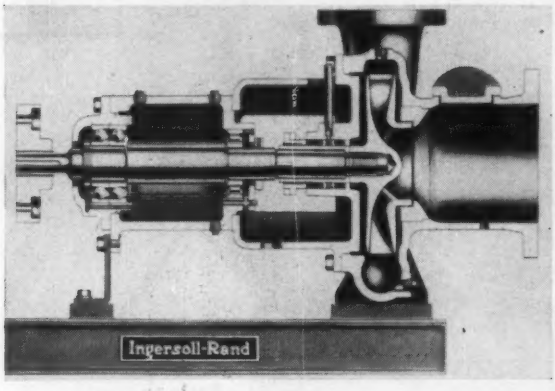


Heavy-duty pump handles abrasive slurries

213 • Low speed, continuous-duty pump is designed to handle abrasive slurries of cement, sand, coal, solids, chemical sludges, etc up to maximum fluid consistency under suction lift or positive head. An all-metal pump, the *Type Q* is available in seven models from 2 to 6-in. size.

By removing four bolts, unit can be opened for most maintenance requirements without disturbing piping. Interchangeable liners on both sides of impeller puts wear on easily replaceable parts. Request bulletin 186 from manufacturer.

Morris Machine Works, Baldwinsville, N.Y.



Paper stock and industrial liquids pump

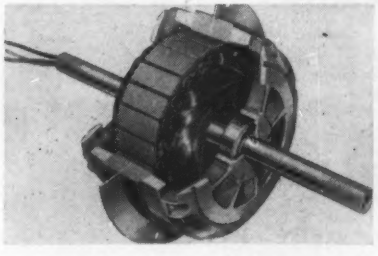
214 • Centrifugal pump features a diverging-type impeller that enables unit to handle liquids containing high concentrations of solids, air and gases. This impeller has a much greater area at discharge than at inlet. With conventional-type impellers the reverse is true. Manufacturer states that this unique design further prevents vapor binding, avoids clogging, makes pump self-venting, self-regulating.

Pump is a horizontal single-stage unit, built in sizes from 4 to 12 in. with capacities from 200 to 7000 gpm and heads from 5 to 225 ft.

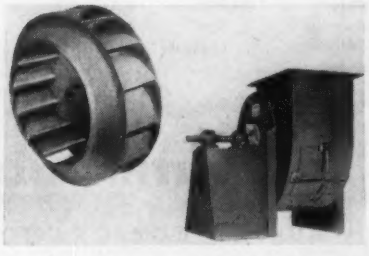
In pulp and paper mills, unit will handle stock at concentrations as high as 10%. Further information in bulletin 7325 obtainable on request to the manufacturer.

Ingersoll-Rand Co, 11 Broadway, New York 4, N.Y.

Don't miss these items and many others appearing on pages noted below:



Fractional-hp blower motor . . . p 174



New-type centrifugal fans . . . . . p 176

Centrifugal dust collector . . . . . p 174
All-purpose flushing gun . . . . . p 178
Portable fire extinguishers . . . . . p 180
Y-type pipe strainers . . . . . p 182
Automatic dispatching system . . . p 184
Constant support hangers . . . . . p 186
Abrasion-resistant piping . . . . . p 188
Static pressure controller . . . . . p 190
Spherical union connection . . . . . p 192

For more details on these items, use post cards p 169. Identify your request with item number.

If you are concerned with:

Reactor development...
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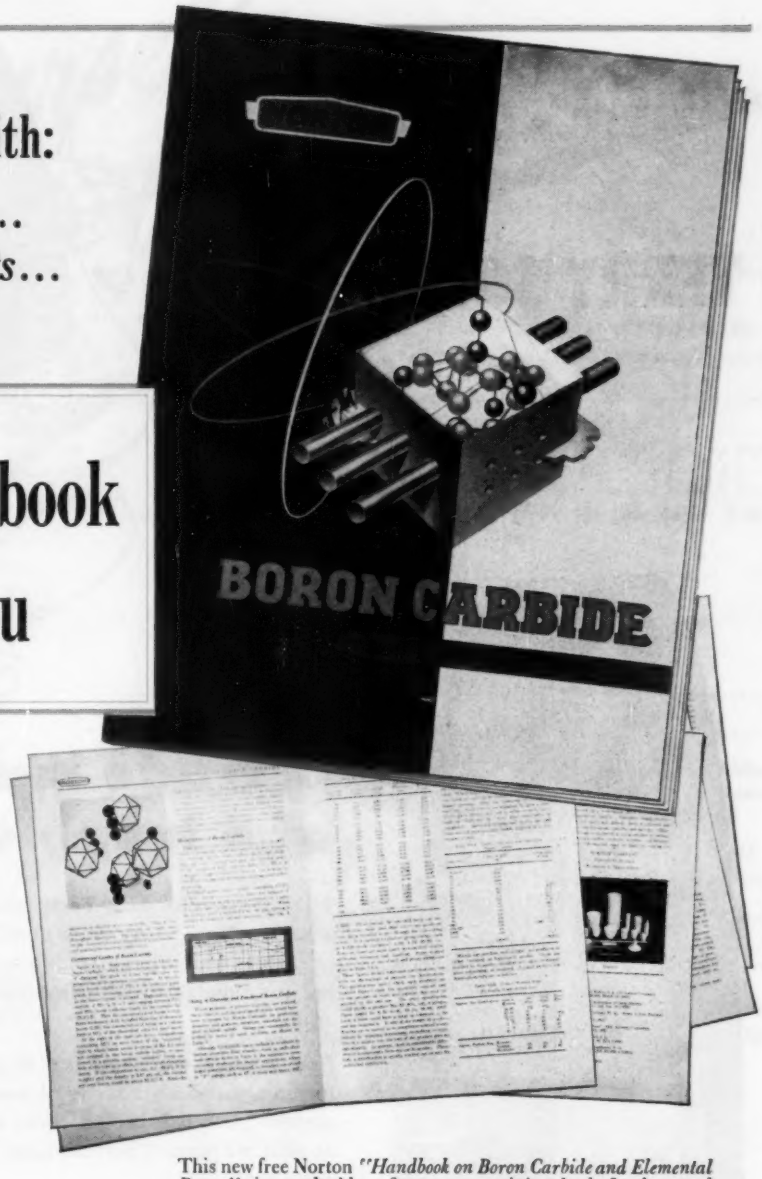

This new free Norton *"Handbook on Boron Carbide and Elemental Boron"*, is a valuable reference, containing both fundamental data and practical information. Printed in colors with many charts and tables it will serve as a useful and permanent addition to the reference files of those concerned with atomic energy and related fields.

In nuclear science and engineering the importance of the neutron absorption reaction of the boron isotope B^{10} is well recognized.

Now, for the first time, available data on the development of numerous stable, boron-rich materials have been compiled and coordinated by Norton in one convenient reference book.

This book is the *"Handbook on Boron Carbide and Elemental Boron"* — a compact source of technical information on materials made by Norton for use in the atomic energy field.

A partial list of the table of contents includes: *Boron for neutron absorption . . . Technical grade boron . . . Properties of boron . . . Commercial grades of boron carbide . . . Radiation damage to boron carbide . . . Bonded boron carbide (carbon, silicate, plastic, metal) . . . Boron nitride . . . Metal borides.* These and many other subjects are fully described and illustrated with tables, charts and photographs.

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Work in Norton laboratories on boron compounds began some 25 years ago. This included the development of NORBIDE* boron carbide, the hardest material yet produced commercially. Norton facilities for producing NORBIDE wear-resistant articles and abrasive have been expanded to supply boron carbide in numerous forms for atomic energy applications.

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Other Norton Electric Furnace Products

of special interest to nuclear engineers include ALUNDUM* fused alumina, CRYSTOLON* silicon carbide, MAGNORITE* magnesium oxide, FUSED ZIRCONIA and various refractory carbides, oxides and nitrides.

Besides being the basic ingredients of the famous Norton Refractory R_x's — refractories *engineered and prescribed* for the widest range of conventional applications — these high-melting materials are finding many new and valuable uses in atomic energy projects.

They are all described in the new Norton handbook. For your free copy, write to NORTON COMPANY, Refractories Division, 441 New Bond St., Worcester 6, Massachusetts.

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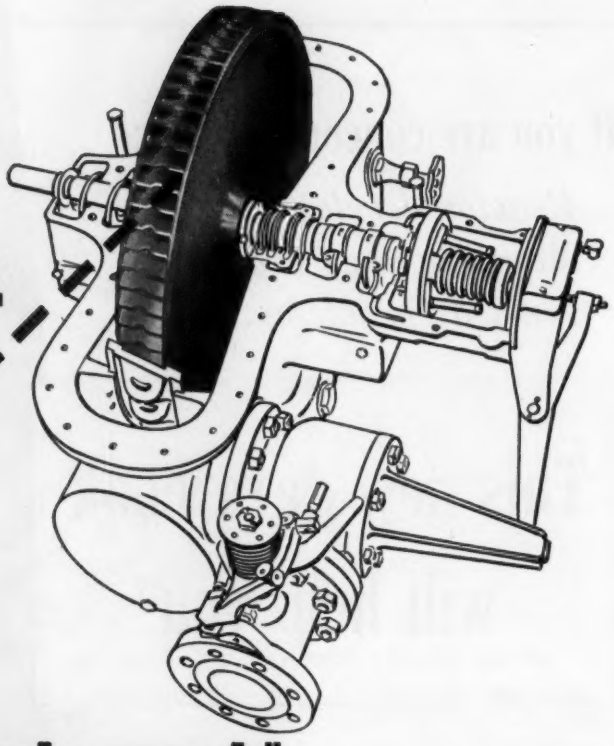
TERRY SOLID WHEEL



..."trade mark" of a trouble-free turbine

This is the rotor of a Terry solid-wheel turbine. There are a number of reasons why it has become a symbol for reliable, trouble-free operation.

First, because the wheel is a single forging, in which a series of semi-circular buckets is milled, there are no separate parts to become loose or work out.

Second, because the power-producing action of the steam takes place on the curved surfaces at the back of the buckets, blade wear is of little consequence. Wear does not materially affect horsepower or efficiency.

Third, because the steam enters the buckets in a direction at right angles to the shaft, there is no need for close axial blade clearances. The blades cannot foul. There is a one inch clearance on either side of the wheel. In addition, the blades are double rim protected.

These are only a few of the reasons why the Terry solid wheel has become a "Trade Mark" for trouble-free turbine performance. For complete details, send for a copy of bulletin S-116. No cost or obligation.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

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AIR CONDITIONING, REFRIGERATION

1 **Air conditioning** and refrigeration equipment. Illustrated 34-p bulletin 80-D describes uses, operating principles, features of company's line. Includes useful refrigeration tables, diagrams, cutaways. Frick Co, Waynesboro, Pa.

2 **"Dehumidified storage** with particular emphasis on preservation of materials within metal hutments" is title of 16-p bulletin DS-1. Contains photos, diagrams, application and installation data. Desomatic Products, Inc, Falls Church, Va.

★ **Airfoil centrifugal fans,** said to achieve efficiencies of above 82% and operate at 35% less power than is required by conventional flat-blade fans of the same capacity, are described in bulletin A-102. ★Request direct on company letterhead from Chicago Blower Corp, 9869 Pacific Ave, Franklin Park, Ill.

BOILERS AND AUXILIARIES

3 **Steam generators,** *Type WTP,* are detailed in illustrated 14-p bulletin 5511. The 2-drum boilers are shop assembled—produced in steam capacities of 7500 to 40,000 lbs per hr. The Titusville Iron Works Co, division of Struthers Wells Corp, Titusville, Pa.

4 **Water-tube boilers,** packaged units for capacities to 50,000 lb per hr, are described in revised 12-p catalog 100-D. Complete data, dimensions, photos. Superior Combustion Industries, Inc, 1475 Broadway, New York 36, N. Y.

5 **Refractory specialties.** Illustrated 16-p catalog describes plastic and castable refractories, cements and mortars from packaging to completed installations. Also outlines many uses in ferrous and non-ferrous metal furnaces, aluminum reverberator melting furnaces, annealing ovens and heat-treating furnaces. The Ramtite Co, Div of The S Obermayer Co, 2563 W 18th St, Chicago 8, Ill.

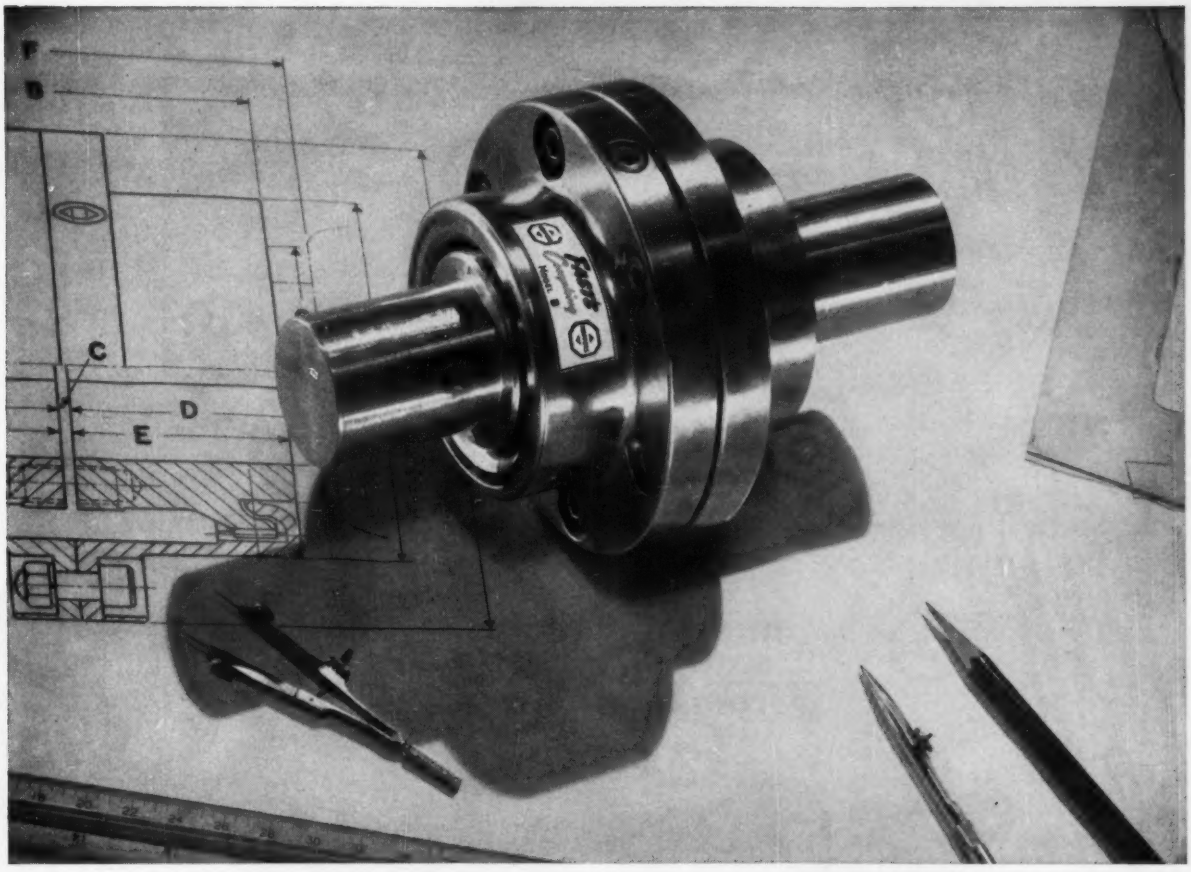
6 **Feedwater heaters,** packaged deaerating spray type for medium and small boilers, are subject of 4-p bulletin 614. Includes photos, cutaway, selection chart. Elgin Softener Corp, 134 N Grove Ave, Elgin, Ill.

HEAT EXCHANGERS

7 **Shell and tube heat exchanger** dimensions, data and capacities are provided in this 12-p bulletin. Aids in selection of the more commonly used types of water heaters, converters and condensate coolers. Buxton Manufacturing Co, Dover, N. J.

8 **Heat exchanger** and condenser tubes are detailed in 8-p bulletin TB-329B. Covers all popular grades of carbon, alloy and stainless steel tubing—both seamless and welded. Tubular Products Div, The Babcock & Wilcox Co, Beaver Falls, Pa.

(*Continued on page* 220)



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The new MODEL B fills the needs of manufacturers of fans, blowers, pumps and other light-to-medium drive units where coupling *cost* is as important as performance. Koppers engineers designed it to eliminate the cost barrier and offer Fast's rugged design and trouble-free performance for hundreds of new applications.

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The new Fast's MODEL B Coupling may offer a profitable solution to your light or medium drive coupling problems. Find out how by writing for full details to: KOPPERS COMPANY, INC., Fast's Coupling Dept., 3302 Scott St., Baltimore 3, Md.

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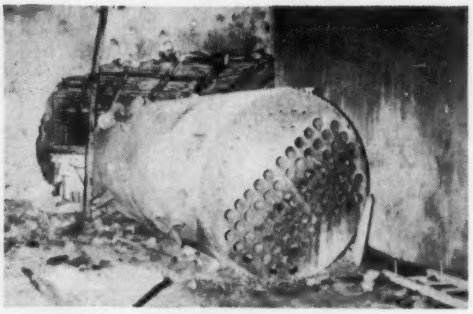


George Edwards

has a thought-provoking visit from an old friend

► WE HAVE FRIED APPLES for supper now and then at our house. With a smaller family this winter, I get more, and probably eat more of them than I should. Just as I was forcing myself away from the table, the phone rang.

It was Vance Myers. Vance is a boiler inspector I've known for twenty years, off and on. When I was chief engineer for the Quiream Paper Company he often spotted little things that wouldn't have cost his insurance company a nickel. But his suggestions saved me many a headache. Good man, Vance. I was happy to tell him to come on out when he said he wanted to see me.

He'd been investigating a nasty accident in a laundry near here. Two dead. He was upset—wanted to talk. I sat back and listened.

"Typical of management that puts the squeeze on the engineer. No time out for cleaning and inspection. The law makes annual internal a must, but it's like pulling teeth to get it. I offer to give up a weekend with my family to make the inspection, but management thinks only of overtime they'd have to pay their crew.

"Last spring I spotted scale build-up on the rear head. Asked to have the boiler opened every few months. Water-treatment engineer wanted samples. We'd have licked it. No dice. They just wanted steam.

"Night before last, tube ends started to leak. Some jerk dropped the pressure, rolled the ends. Just cracked the scale. Next morning, all hell broke loose when they fired her up. Tubes pulled out of the sheet; 175 pounds pressure. Just like a rocket —whammo—through four brick walls. Take a look at these pictures."

I looked at the pictures. Vance lit his pipe. I didn't say anything. What was there to say?

"But," Vance added, "sometimes it's not management, it's lazy engineers. Sample boiler water? Check softeners? Test controls? Too much effort. Some like two low-water fuel cutoffs. Figure if one doesn't work, the other will. Good idea, but if you let the float chambers fill with sediment, a dozen won't do any good.

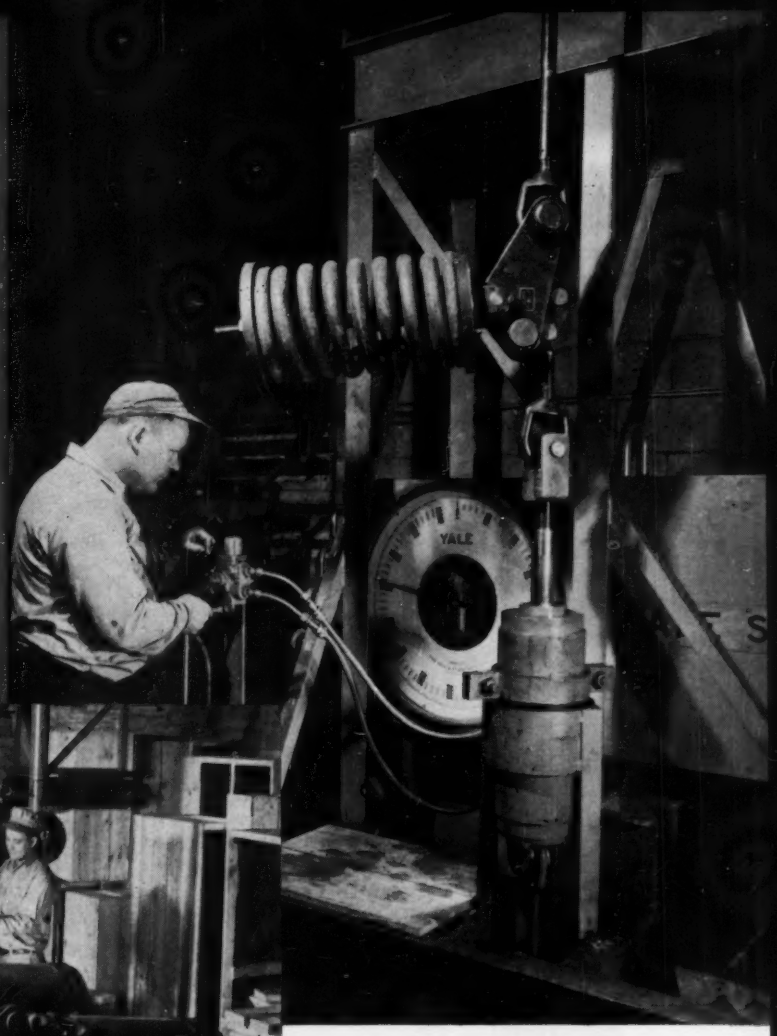
"I find relays blocked in; jumper wires in control circuits. If your business is melting down boilers for scrap, that's a good way to do it.

"Inspectors must approve major repairs, but some engineers and management learn it the hard way. Last month, I condemned a boiler after a quickie repair. A fly-by-night welder, wrong material, patch too big, not a staybolt in sight. Pinch-penny tactics almost put that place out of business."

Vance knocked out his pipe and looked apologetic. "Guess I sort of get carried away, but I can't understand people taking such terrible risks. Anyhow, thanks for letting me get it off my chest."

Out on our front walk, watching the tail lights of his car dwindle, I thought of Oliver Wendell Holmes' *The Poet at the Breakfast Table:* "It is the province of knowledge to speak, and it is the privilege of wisdom to listen."

here's how high temperature piping can flex its muscles



Each pipe hanger is scale tested to rigid tolerances by a skilled workman at the Navco plant. After final assembly and inspection, the hangers are carefully crated and readied for shipment.

NAVCO *Counterpoise* Pipe Hangers

Since high temperature piping has no respect for equipment connections, the entire piping system must flex its muscles to absorb the strain of expansion and contraction. This prevents serious stresses that could endanger the installation.

And how does high temperature piping flex its muscles? With Navco's precision engineered Counterpoise Pipe Hanger—the hanger with a load-supporting effort that is of constant value throughout the range of travel. This permits weightless movement of the entire piping system.

To learn how power plants, oil refineries and chemical plants can have piping systems that flex their muscles, write today for Navco's 12-page Counterpoise hanger bulletin #153.

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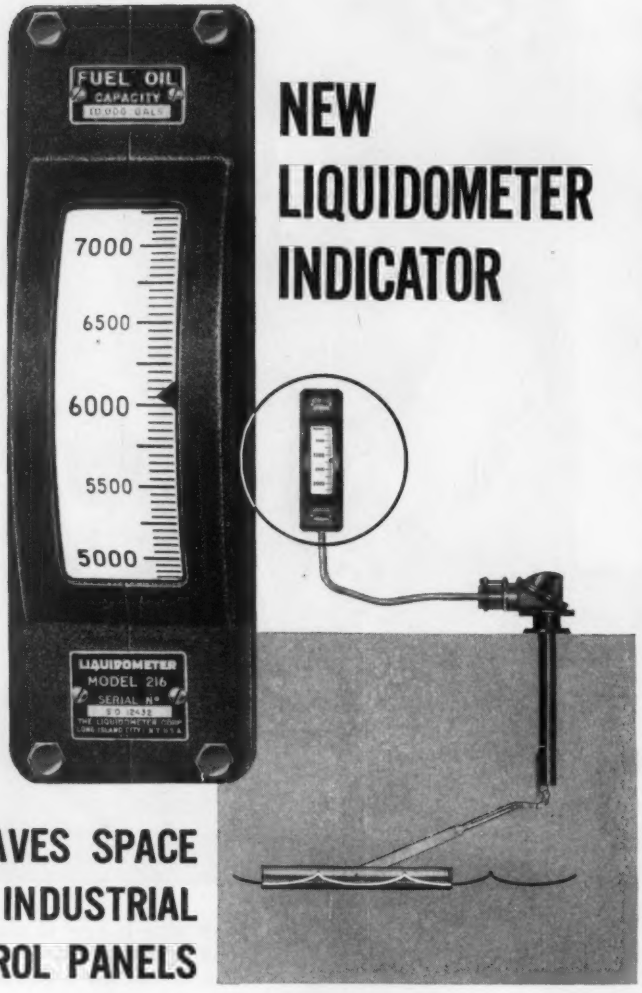


NEW LIQUIDOMETER INDICATOR

SAVES SPACE ON INDUSTRIAL CONTROL PANELS

Twenty-inch dial in 3x10¼" case permits close readings

The new Liquidometer Model 216 Indicator gives the plant engineer a reliable, automatic reading of storage tank contents. Available in either vertical or horizontal design, the compact and highly readable Model 216 Indicator makes possible multiple installations on crowded control panels.

Teamed with Liquidometer's time-tested hydraulic transmission gaging system, the new indicator provides instantaneous remote indication of liquid levels—automatically. No outside power source is required. Virtually any liquid may be measured, and the indicator can be located up to 250 feet from the tank.

Engineered for dependability, the Liquidometer gaging systems highlight these design features:

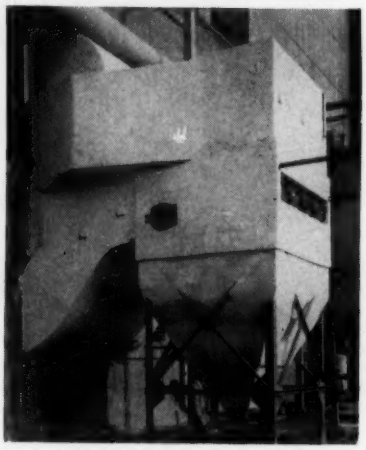
- Maintenance free
- Integral temperature compensation
- Ease of installation—requires only one 2" diameter tank opening
- Safety—all gages Underwriters approved for hazardous liquids

For further details on the new Model 216 Indicator, write Dept. E for Bulletin 532.

THE LIQUIDOMETER CORP.
SKILLMAN AVENUE AT 36th STREET
LONG ISLAND CITY 1, NEW YORK

MORE EQUIPMENT NEWS

Begins on page 160



Centrifugal dust collector

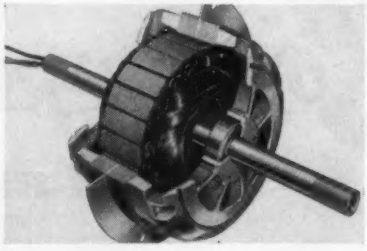
225 • This collector consists of an inlet chamber connected directly to a nest of vertically-mounted separating tubes, a dust-collecting hopper and a clean-gas discharge chamber. Dust-ladened gases enter the collector at velocities sufficient to keep the fine particles of dust suspended. Cleaned gas goes out stack. Practically all dust stays behind in the hopper.

Shape of inlet head and design of guide vanes of each collector tube cause gas to whirl in the space between inner and outer shell of the tube, throwing out more of trapped dust particles than by previous methods, according to manufacturer.

Cleaned gas, still whirling, flows down along length of tube and then moves upward and out through inner shell of tube. Dust particles that are forced to outer shell of tube by this continuous centrifugal action, flow downward and are discharged into the collecting hopper. Details on request.

Hagan Corporation,
323 4th Ave, Pittsburgh, Pa.

For more details on these items, use post cards p 169. Identify your request with item number.



Fractional-hp blower motor

215 • Increased efficiency with reduced size and weight are among features claimed by manufacturer for this integral-drive fractional-hp blower motor. Unit differs from conventional motors in that rotating member is on outside and revolves around a stationary shaft and stator assembly. Lead wires pass through hollow stationary shaft to stator windings.

Integral drive of blower wheel is accomplished by a flange on rotor that connects

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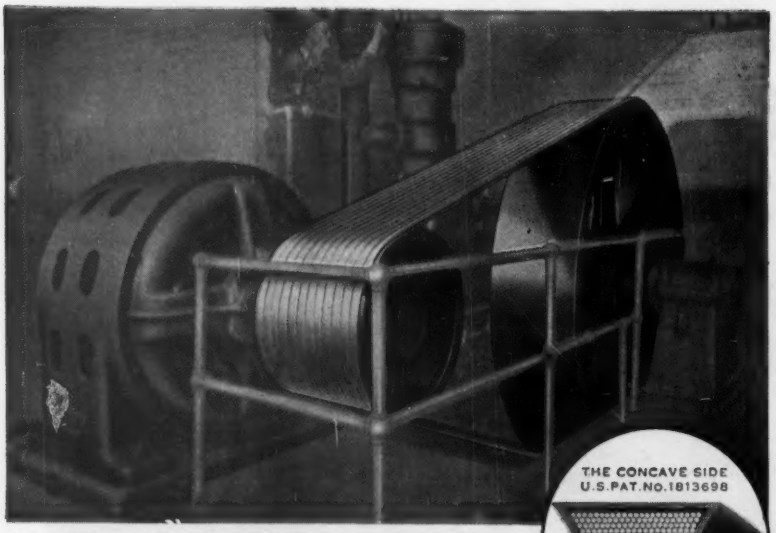


Why a V-Belt with CONCAVE SIDES wears longer

It is easy to demonstrate to yourself why the concave sides (Fig. 1) of the Gates belt greatly lengthen belt life.

Simply bend a Gates belt and feel the sides. Notice how these precisely engineered concave sides *fill out* on the bend and *become straight.* Thus a Gates belt grips the sheave groove evenly (Fig. 1-A) and wear is distributed uniformly across each side of the belt. That means longer belt life; lower costs.

Make the same test with a straight-sided belt (Fig. 2) and see what happens. The sides bulge out on the bend (Fig. 2-A) concentrating the wear at points shown by arrows.

To assure longer wear and keep belt costs down, specify the V-belt with concave sides—Gates Vulco Rope . . . readily available from nearby distributor stocks. The Gates Rubber Company, Denver, Colorado —*World's Largest Maker of V-Belts.*

There are Gates Engineering Offices and Distributor Stocks in all industrial centers of the United States and Canada, and in 70 other countries throughout the world.

TPA 68

Gates VULCO ROPE Drives

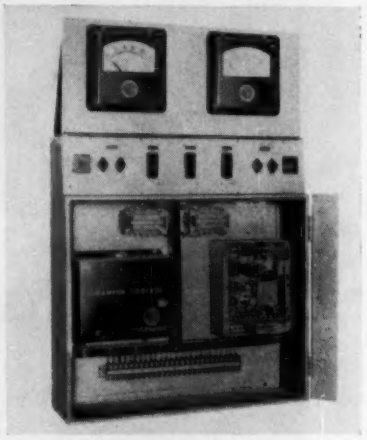
MORE EQUIPMENT NEWS

Begins on page 160

directly to the wheel—eliminating necessity for belts, pulleys or special motor mounts. Wheel and motor share a common shaft and common bearings.

Motor itself is a sixpole permanent split-capacitor type. Full load speed is 1050 rpm, but speed can be controlled by varying the voltage. First production models are rated at ¼ hp. Further details on request.

Iron Fireman Manufacturing Co, 2838 SE 9th Ave, Portland, Ore.

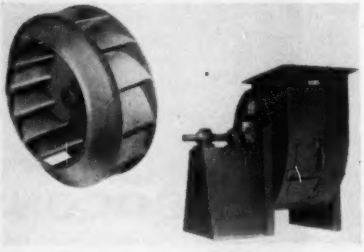


Panel control systems

217 • *Fireye* ac panel control systems are claimed to offer complete burner protection and fully automatic operation for commercial-industrial oil, gas and combination oil/gas burners. System combines flame-failure safeguard, programming control, short-circuit protection, motor starters, fuel-selector switches, signals and alarms in a single, integrated panel assembly. Optional equipment available includes sequence draft controls, draft and temperature indicators and provision for switching to modulated or fixed-rate firing. Details on request.

Electronics Corp of America, 718 Beacon St, Boston, Mass.

For more details on these items, use post cards p 169. Identify your request with item number.

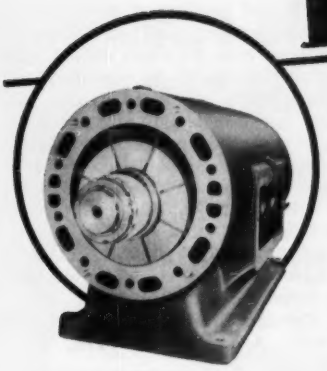


Airfoil centrifugal fans

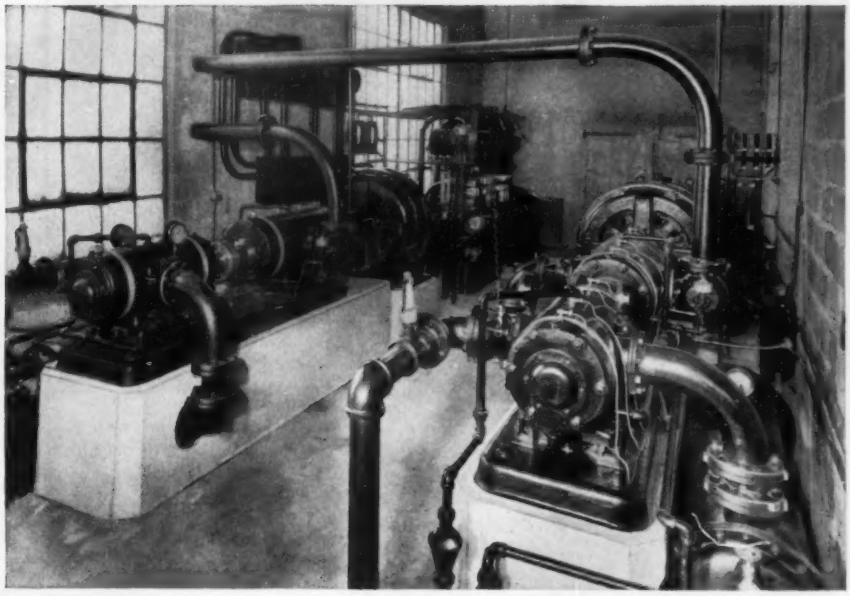
226 • Manufacturer claims that these units achieve efficiencies of above 92% and operate on 35% less power than is required by conventional flat-blade fans of the same capacity.

The backward-curve, non-overloading centrifugal fan features hollow-sectioned aerodynamic-shaped airfoil blades. This blade

Fuller *pioneered*



the two-stage **rotary** compressor . . . for general industrial use . . . starting in 1930



INSTALLED 1930
STILL GOING STRONG ➡
Two Fuller Rotary Two-stage Compressors. Capacity each 740 c.f.m., 100-lb. pressure.

Fuller Company not only pioneered the rotary compressor for industrial use in this country, but it has always stressed the "spotting" of compressors. There's nothing new or startling about this principle . . . Fuller has advocated it ever since its first machines were put on the market in 1930 . . . applying each compressor to a specific job, with resultant overall plant economy, as well as power savings. Result: the adoption of this economical layout by thousands of users has proved to their satisfaction the soundness of such a program.

Fuller has built and sold thousands of Fuller Rotaries—a large proportion of the two-stage type. And, when plant expansion is necessary, with a consequent demand for more air, additional Fullers are naturally installed.

Fuller engineers have never rested on their oars, but have continually worked to improve design and efficiency, until today, these machines are second to none for dependable air-production in industry.

We welcome the opportunity to present to you all the facts concerning Fuller Rotary Compressors, facts built on actual operational experience. For a complete description of Fuller Rotaries, write for Bulletin C-5A.

FULLER COMPANY
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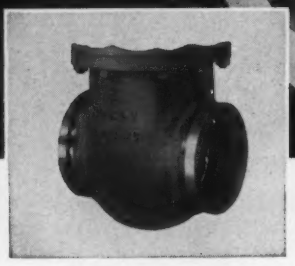
YOURS FOR MOST ANY GATE VALVE SERVICE

...The advantages of DARLING fully revolving disc design!



Darling Victaulic end gate valves are made in accordance with specifications to fit standard Victaulic couplings... just one of the many various types of ends offered by Darling to meet your specific installation requirements.

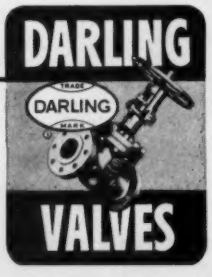
THE Darling *fully revolving, double disc, parallel seat* principle simplifies gate valve operation and cuts maintenance and replacement costs.

Darling offers this type of gate valve in sizes and alloys for practically any service you can name.

Regularly available in iron body, cast steel, rubber lined iron body, all bronze and special alloys . . . for ordinary and unusual services. Made with various type ends to meet your particular installation needs.

Write for complete information on Darling Gate Valves . . . the valves that give you the most dependable, maintenance-free valve service you've *ever* had.

DARLING VALVE & MANUFACTURING CO.
Williamsport 8, Pa.
Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.



MORE EQUIPMENT NEWS

Begins on page 160

design is said to eliminate eddy currents that create turbulence and noise. Units are available in direct or V-belt designs. Fan meets all requirements for commercial and industrial ventilating, air conditioning and heating application, plus forced and induced draft. Steep-pressure characteristic curve and low noise level recommend its use for high-pressure air-conditioning systems, manufacturer states. Wheel sizes are from 13½ to 143 in. in diameter. Descriptive bulletin A-102, Type A, obtainable by writing to manufacturer direct on your company letterhead.

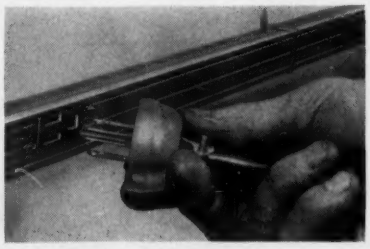
Chicago Blower Corp, 9869 Pacific Ave, Franklin Park, Ill.

All-purpose flushing gun

229 • Unit will clean pipelines of grease, rags, sand, scale and other obstructions. It is operated by a trigger that releases a hammer blow against water in the pipeline. Water in line acts as a flexible shaft and this impact instantly dislodges all obstructions, manufacturer states. The gun may be used for cleaning clogged sinklines, floor drains, toilet bowls, hot-water pipes, grease traps, stack pipes, etc. Detailed catalog available on request to manufacturer.

Miller Sewer Rod Co, 4642 N Central Ave, Chicago 30, Ill.

For more details on these items, use post cards p 169. Identify your request with item number.



Plug-in strip and raceway

234 • Plug-in strip is equipped with an integral raceway to handle branch circuit conductors in addition to its standard use in providing electrical outlets. It was developed as a method of running branch circuits 110 and 220-volt service, in the same duct that carries the plug-in strip

Users of tubing for cylinder applications—now you can have this new...

J&L Cold Drawn ELECTRICWELD

Tubing with a Special Smooth ID Finish

Reduces your overall production costs in applications like these . . .

- **cylinder tubing**
- **hydraulic and pressure tubing**
- **shock absorbers**
- **ordnance components**

This new drawn-over-mandrel grade tubing with its mirror-like inside surface finish is today busy helping manufacturers reduce or entirely eliminate costly machining on many applications and is being substituted for more costly types of steel tubing. For example, it may be used, without inside honing, for many cylinders through which plungers are passed.

J&L Cold Drawn ELECTRICWELD Tubing with a *Special Smooth* ID finish combines the physical advantages imparted by today's modern electric welding techniques with those of cold working. It withstands high internal hydrostatic pressures, carries heavy torsion loads, resists high-frequency vibration, and offers a favorable weight-to-strength ratio for applications in which loading occurs in all directions.

J&L Cold Drawn ELECTRICWELD Tubing can be furnished in its three specifications in OD sizes from ¾-inch to 2¼ inches and in wall thickness from 20 to 10 gage, 0.035 and 0.134-inch respectively.

This new booklet provides the information you need . . . specifications . . . tolerances . . . chemistry . . . mechanical properties . . . annealing . . . finishes.

Send for your free copy today!

J&L STEEL

Jones & Laughlin Steel Corporation
Dept. 511, 3 Gateway Center, Pittsburgh 30, Pa.

Send me a copy of your new Cold Drawn ELECTRICWELD Booklet.

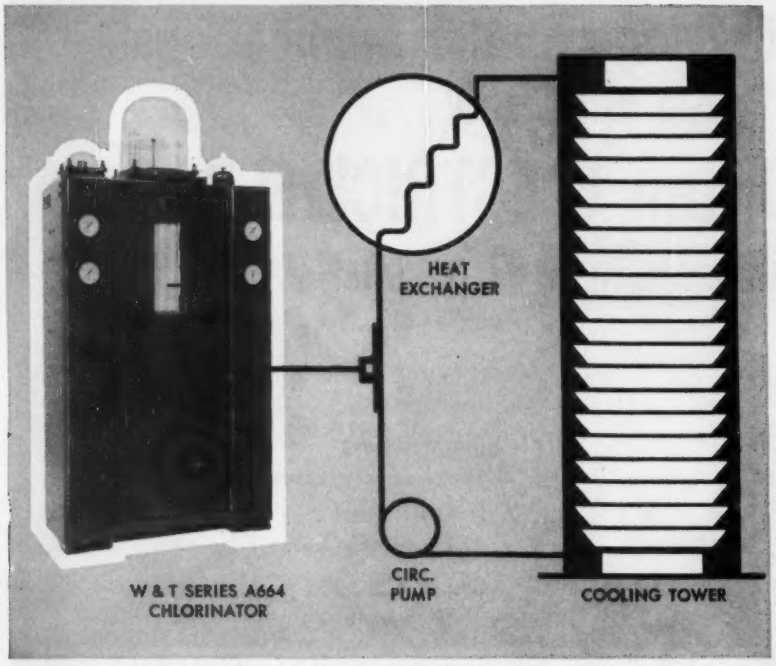
Name_____

Title_____

Company_____

City_____ Zone_____ State_____

Slime Control...



...Chlorination of Cooling Water Circuits

Heat transfer losses caused by slime formation on condenser and heat exchanger water-side surfaces can be eliminated by chlorination of the cooling water. Water and air-borne organisms—the cause of slime formations—are effectively and economically controlled by Wallace and Tiernan chlorination systems.

The Wallace and Tiernan Series A-664 Chlorinator shown above is one of a complete line of W&T chlorination equipment, designed to give dependable chlorination at all feed ranges. It is used at large plants where cooling water chlorine requirements call for a durable high capacity unit.

We Invite Your Inquiries

Technical information on cooling water chlorination is available in our free booklet, RA-2061-C. Bulletins on chlorination of industrial process water and industrial waste treatment are also available. Write us for your copy.

WALLACE & TIERNAN INCORPORATED
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

CD-40

MORE EQUIPMENT NEWS

Begins on page 160

harness. These provisions make possible a normal plug-in strip installation while providing capacity to handle additional single-phase or three-phase load within limits of the Number 10 conductors.

A ¾-in. knockout at each end of a 6-ft strip, allows in-and-out accessibility of additional branch circuit wires without special feed fittings.

Unit will serve commercial and industrial applications with their characteristically heavier loads, manufacturer states. Particularly adaptable for air-conditioning unit installations, the plug-in strip is available with either standard two-wire or grounded-type receptacles every 6 or 18 inches. Request details from manufacturer.

National Electric Products Corp, Gateway Center, Pittsburgh, Pa.

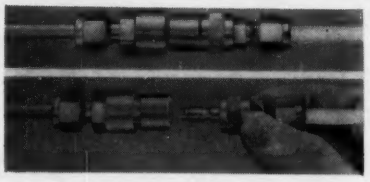
Portable fire extinguishers

220 • New line of wet chemical units includes a 2½-gal pressure-operated combination water and anti-freeze extinguisher. Due to its tin-lined brass container construction, this extinguisher is completely non-corrosive and may be charged with either clear water or anti-freeze solution. Charging pressure is only 100 psi.

Other additions are 2½-gal. and 5-gal. pump-tank-type extinguishers using either stainless steel or copper containers and which may be charged with clear water or anti-freeze solutions. New 1-qt and 1½-qt and 1-gal. carbon tetrachloride extinguishers and chlorobromomethane extinguishers are pressurized with either air or nitrogen to 150 psi. Each shell is tested to 500 psi and has UL approval.

Walter Kidde & Co, Inc, Belleville, N. J.

For more details on these items, use post cards p 169. Identify your request with item number.



Quick-connect fittings

231 • No tools are required to connect or disconnect these *Swagelok* fittings. A shut-off valve incorporated in the unit acts as a positive seal to prevent any leakage dur-

A SUPER HYBOND arch was installed in a B & W coal fired boiler, with a chain grate stoker, in an Indiana Municipal light plant. The boiler is rated at 125,000 lbs. per hour, and operates at about 200% of rating. Prior to the use of SUPER HYBOND it was necessary to replace the arch in this boiler every 9 months. The SUPER HYBOND arch was not replaced for 3½ years and even then, as shown by the photos, could have given additional service.

SUPER HYBOND arch as installed.

A.P. GREEN

Super Hybond Suspended Arch Gives More Than 4 Times the Service of Previously Used Refractory Arch

SPECIFY A. P. GREEN PLASTIC FIREBRICK LININGS for longer life... lower maintenance costs

For over 30 years, A. P. Green plastic firebrick, made from highest quality Missouri fire clays, has been proved in service. Four grades of plastic to meet varying refractory needs.

warehouse stocks for prompt shipment

Look in the classified section of your telephone directory or write direct for the name of the A. P. Green distributor in your locality. He has complete stocks and can make prompt delivery.

SUPER HYBOND arch after 3½ years' service.

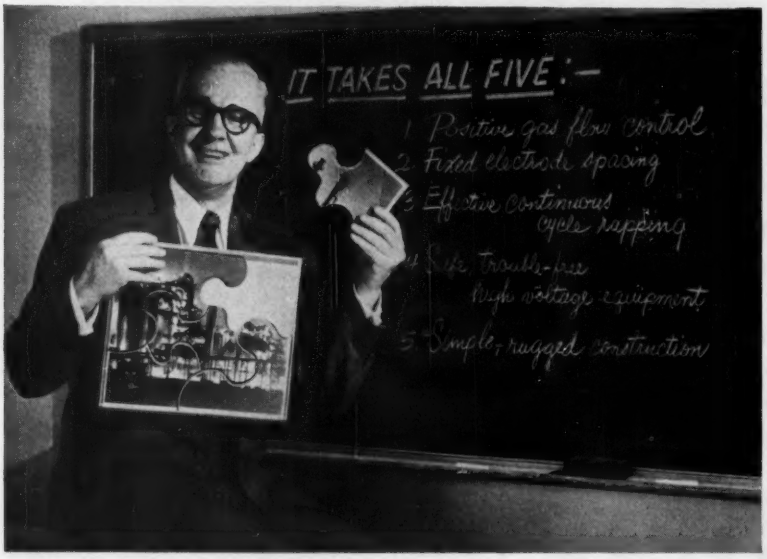
A. P. Green
REFRACTORY PRODUCTS

SERVING THE WORLD'S INDUSTRIES

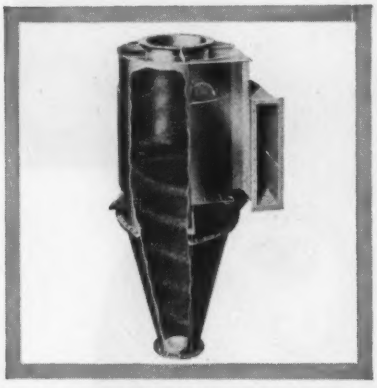
A. P. GREEN FIRE BRICK COMPANY
Mexico, Missouri, U. S. A.

PLANTS: Mexico, Mo. • Woodbridge N. J. • Sulphur Springs, Texas
IN CANADA:
A. P. Green Fire Brick Company, Ltd., Toronto 15, Ontario

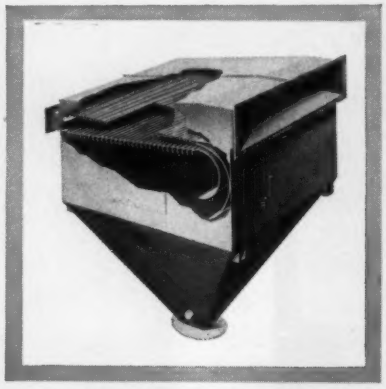
Buell 'SF' Electric Precipitators meet all 5 basic requirements for TOP EFFICIENCY


IT TAKES ALL FIVE:—
1 Positive gas flow control
2 Fixed electrode spacing
3 Effective continuous cycle rapping
4 Safe trouble-free high voltage equipment
5 Simple, rugged construction

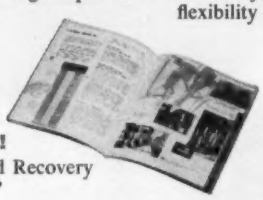
A slight deficiency of any single factor would be sufficient to impair the performance or service life of any dust recovery system. The constant top efficiency of Buell installations is the result of skillfully adjusting all five elements to best meet various operating conditions . . . provide consistent top efficiency, day after day.



Buell Cyclone Collectors are noted for their efficiency, too. Here are exclusive reasons why: shave-off design which harnesses back-flow and puts it to work . . . plus extra large diameter design to prevent "plugging."



Buell "LR" Fly Ash Collectors are ideal for low and high pressure boiler operations up to 2000 BHP, with either natural or mechanical draft. Check them for high efficiency, simple design, compactness, flexibility in layout.



FREE BOOKLET!
"The Collection and Recovery of Industrial Dusts"
Write to:
Buell Engineering Company,
Dept. 50-B, 70 Pine Street,
New York 5, New York

buell®

MECHANICAL ELECTRICAL

Experts at delivering Extra Efficiency in
DUST COLLECTION SYSTEMS

More EQUIPMENT NEWS

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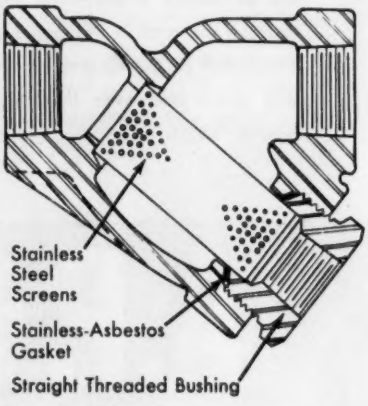
ing either the connecting or the disconnecting operation.

Used with plastic and metal tubing, these fittings are available in all metals, in sizes to fit ordinary applications and in three types: (1) tube to tube with *Swagelok* ends (2) tube to pipe with one *Swagelok* end (3) bulkhead, either tube to tube or tube to pipe. Photos above show fittings with *Swagelok* ends joining copper tubing, left, and flexible plastic tubing, right.

Crawford Fitting Co, 884 E 140th St, Cleveland 10, Ohio



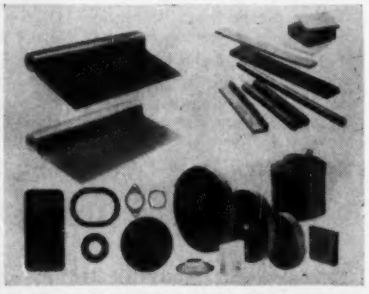
Y-type pipe strainers

221 • Six sizes of carbon-moly-steel strainers are available for oil, gas, air, water and steam lines. They are suitable for pressures to 900 lb and temperatures to 900 F. Maximum pressure at 100 F is 1800 psig. The units are made in ½ through 2-in. sizes, either screwed or socket weld. Sizes 1¼, 1½ and 2-in. have bolted retainer plates. Smaller sizes have straight-thread screwed bushings.

A stainless-asbestos gasket is locked in between body and base of bushing—eliminating chance of blowout.

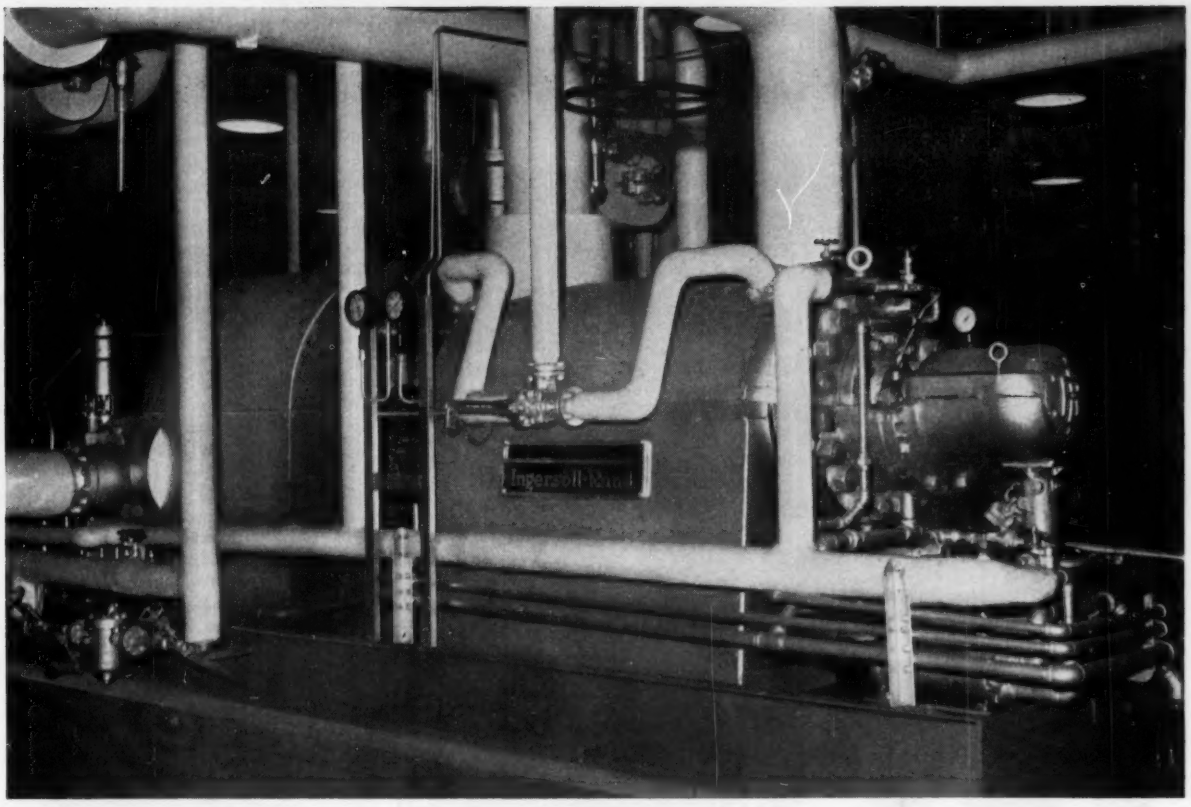
Armstrong Machine Works, Three Rivers, Mich.

For more details on these items, use post cards p 169. Identify your request with item number.



Rubber sheet packings

222 • New line of pure gum and synthetic rubber packings are available in standard rolls or in die cut designs for special industrial applications. Stocks include: (1) Super red and black sheets in nylon and plate finishes for hot and cold water, gen-



Great Northern Paper Co. gets

PERFORMANCE PLUS ECONOMY

with New I-R Boiler-Feed Pumps

At East Millinocket, Maine, the Great Northern Paper Company is completing a $45,000,000 expansion program that will bring total mill capacity to 1,000 tons of newsprint per day. Constructed by Stone and Webster Engineering Corp., this mill represents the last word in modern paper-making methods and equipment.

In the new and completely modern power plant, boiler feedwater is handled by three identical Ingersoll-Rand 10-stage double-case pumps, each rated 757 gpm, 1554 psi discharge, 287°F. The cylindrical, double-case construction of these Class CHTA high-pressure pumps simplifies maintenance, permits equalized thermal expansion of all internal parts and assures sustained high efficiency. This extra performance means long-range *economy* in heavy-duty service.

Other I-R Cameron pumps are also widely used throughout this ultra-modern mill. In fact you'll find the familiar I-R nameplate on more than 70 units in various plant and process services.

Whatever your liquid-moving requirements, there's an I-R pump that's *right* for the job. Any time you have a pumping problem, your Ingersoll-Rand representative will be glad to help you.

Ingersoll-Rand 11 BROADWAY, NEW YORK 4, N. Y. 10-310

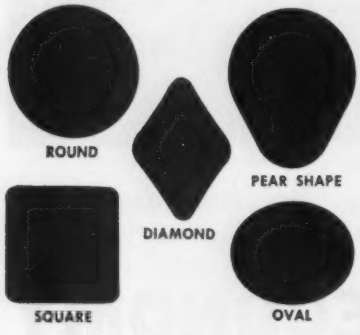
PUMPS • COMPRESSORS • CONDENSERS • DIESEL ENGINES • VACUUM EQUIPMENT • AIR AND ELECTRIC TOOLS

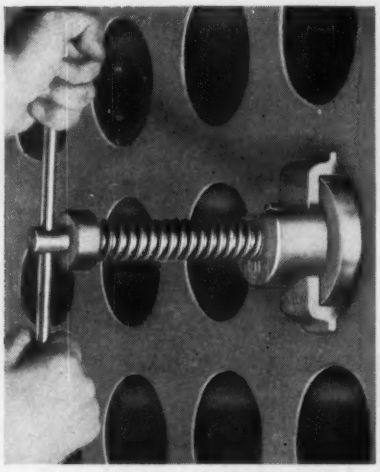
ROTO *Hand Hole* Seat Scraper

Eliminates Dirty, Tedious Work

Here is a simple, hand-operated tool for cleaning inside caps on boilers that will pay for itself many times over. This tool is equipped with retractable knives mounted on a revolving spindle having a bearing within a substantial yoke. An adjustable spring automatically maintains tension on the knives, sufficient to remove all foreign matter but not enough to cut the metal. A few turns to the right, and the job is done. A half turn to the left releases the tool. Try a Roto Seat Scraper and you'll wonder how you ever got along without one.

These are some of the hand hole shapes cleaned with a Roto Seat Scraper. Various sizes available.





Illustrating ease of operation of Roto Hand-hole Seat Scraper.

Roto Hand-hole Seat Scraper for B & W Boiler.

What Users Say—

It did a fine job. Completed the work in 80% less time. *(Engineer, Chemical Plant)*

Roto Seat Scraper has paid for itself many times over on our Keeler Boiler. *(Supt., Public Utility)*

One man cleaned inside cap seats on boiler header in 4 hours. Formerly took 2 men 3 days. *(Pennsylvania Manufacturer)*

We also make a Reseating Machine for cleaning outside caps to assure a smooth, true fit. Send for details.

SEND FOR BULLETIN

ELLIOTT COMPANY - ROTO DIVISION

Tube Cleaner Specialists Since 1910

153 Sussex Avenue, Newark, N. J.

MORE EQUIPMENT NEWS

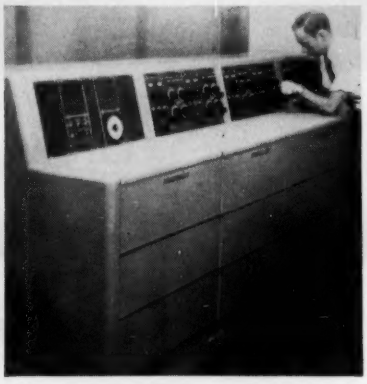
Begins on page 160

eral hydraulic conditions, steam and gas pressures; (2) Chute lining and skirt board rubber, all rubber and fabric back, that resists cutting and abrasion in such uses as lining tanks, chutes, troughs and as skirt boards on conveyors; (3) Amber, pure gum, floating stock for vibration dampeners, flexible joints, soft cushions, bumpers and soft sealing gaskets in hydraulic and general chemical services; (4) Commercial grade black and black neoprene for oil and solvent resistant seals and gaskets on doors, joints, pumps, tanks or pipelines; (5) Black diaphragm sheet for blankets, cut gaskets, reducing valves and regulators to resist swelling in petrochemical, acid, alkali and comparable service. Sponge rubber sheet can be furnished in soft, medium and firm densities with special colors to order.

Rubber sheet comes in standard 36 and 42-in. rolls in thicknesses from 1/16 in. Specially designed shapes for gaskets, diaphragms, etc, made to specification.

Quality Rubber & Transmission Co, 2203 W Chicago Ave, Chicago, Ill.

For more details on these items, use post cards p 169. Identify your request with item number.



Automatic dispatching system

233 • System is said to be first to perform the routine and repetitive functions of electric utility production departments as well as to automatically regulate power generation for fluctuating customer needs.

System consists basically of a remote-position repeating selsyn circuit that requires only a single control channel to each generating station. It adjusts total generation to maintain desired average conditions of frequency and tie-line load.

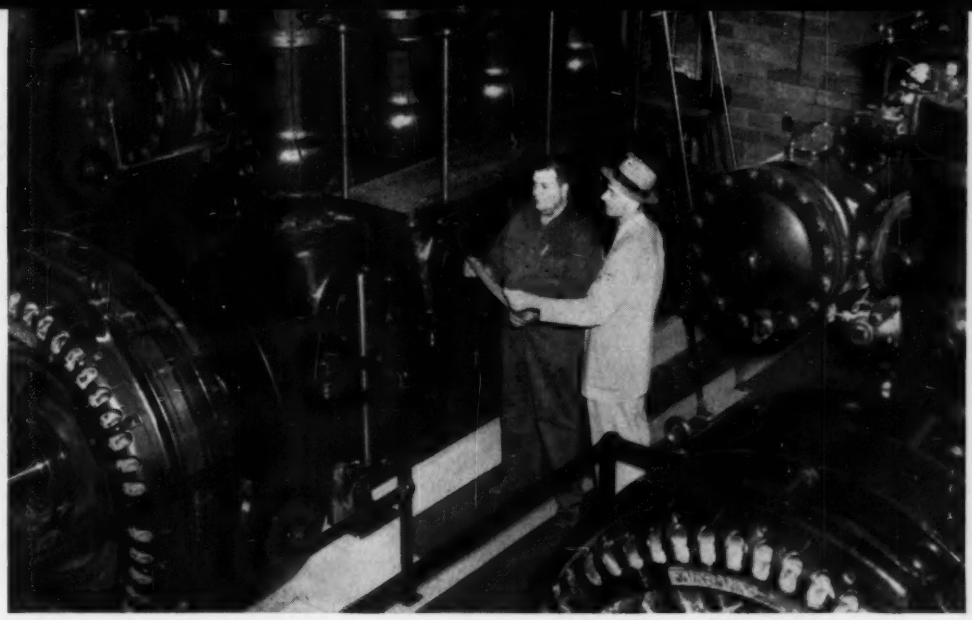
Four console sections—master-area, dispatching, master-station and turbine-control—make up the system.

Master-area section contains controls for determining mode of operation for the system as a whole.

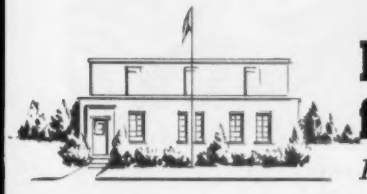
Dispatching section contains controls for inserting transmission-loss penalty factors and means for providing signals for wire line, carrier or microwave channel to each station.

Master-station section has controls for determining mode of operation of the station as a whole.

Turbine-control section has controls for



Melvin Nissen (left) plant superintendent Graettinger, Iowa, and Standard Oil lubrication specialist R. R. Spargo inspect maintenance records. Assisting customers with lubrication problems is something for which Bob Spargo is well qualified. He is a mechanical engineer with a degree from Iowa State College and a graduate of the Standard Oil Sales Engineering School. Bob has been providing lubrication technical assistance to Standard customers for nearly nine years. Customers find his experience and training pay off for them.



How STANDARD D&G Oil helped lick five problems in one plant

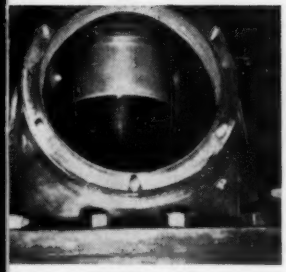
Excessive deposits, excessive maintenance, high oil consumption, were among problems solved by change-over to STANDARD D&G Oil at Graettinger, Iowa, Municipal Light Plant

Three years ago the Graettinger Municipal Light Plant began using STANDARD D&G Oil. Prior to this change-over, good engine performance was hampered by:

1. **Excessive carbon deposits**
2. **Excessive port carbon**
3. **Stack fires**
4. **Ring sticking**
5. **High oil consumption**

The plant averages 4.3 million HP hours of operation annually. Before changing to STANDARD D&G Oil, ports had to be cleaned several times a year. Now, with STANDARD D&G Oil in the engines, ports aren't touched between annual overhauls. Ring sticking and piston and cylinder deposits are virtually eliminated. All of this has been accomplished while continuing the use of low cetane, low gravity fuel.

Good management, careful maintenance and STANDARD D&G Oil have teamed to deliver this performance at Graettinger. Maybe you would like to use STANDARD D&G Oil to obtain similar performance from your engines. A Standard Oil lubrication specialist is nearby in any of the 15 Midwest and Rocky Mountain states ready to show you. Call him. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.



Piston of one of F-M engines at Graettinger Light Plant. STANDARD D&G Oil has kept maintenance down, cut piston and liner wear.

Standard man Bob Spargo (left) and plant superintendent Melvin Nissen inspect piston through crankcase inspection plate hole. With STANDARD D&G Oil, light plant has cut oil consumption in half.

***Quick facts about* STANDARD D&G OIL**

1	Made from highest-quality solvent-refined stock.
2	Contains additives which impart superior detergent-dispersant and anti-corrosion properties.
3	Anti-foaming.
4	Oxidation resistant.
5	Recommended for use (1) with economy fuels, (2) in extreme-load and/or low temperature service.

STANDARD

STANDARD OIL COMPANY
(Indiana)

PIONEER AND LEADER FOR 25 YEARS...

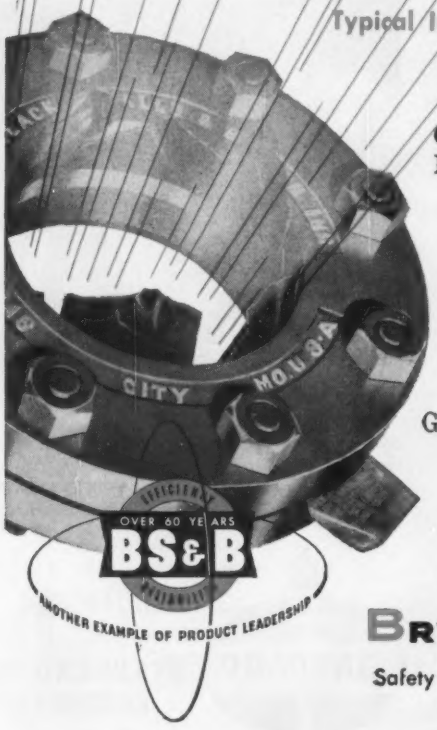
BS&B Safety Heads

THE "CIRCUIT-BREAKER" OF PRESSURED SYSTEMS

The introduction of the BS&B Safety Head some 25 years ago presented industry with an entirely new type of precision safety device designed to protect equipment wherever overpressure was a problem.

Down through the years many special and improved models of BS&B Safety Heads and rupture discs have been developed to take care of specialized applications. Thousands upon thousands of them are "on-the-job" today guarding pressured systems in virtually every type of industry.

From our stock of thin ductile metals (which is the widest assortment in the world assembled in any one place) we can fabricate over 95% of all rupture disc orders from materials on hand.



Typical Industries Which Use BS&B Safety Heads:

Chemical Processing
Oil & Gas Production, Pipeline and Refining
Power Generation
Food Processing
Air Conditioning and Refrigeration
Transportation
Paper Mills
General Manufacturing

BLACK, SIVALLS & BRYSON, INC.

Safety Head Division, 2-Q2
7500 East 12th Street
Kansas City 26, Missouri

MORE EQUIPMENT NEWS

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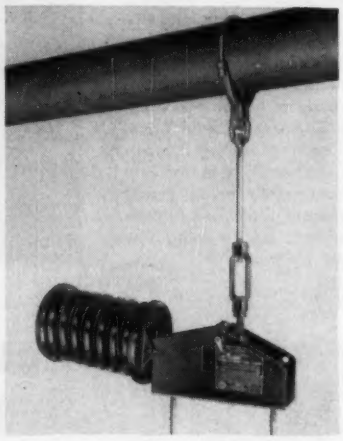
determining mode of operation of individual turbines and for inserting complete incremental cost data for the individual turbine and boiler combination.

General Electric Company, Schenectady 5, N. Y.



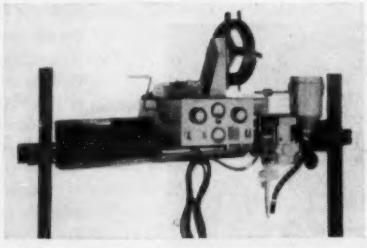
Constant support hangers

227 • These hangers are used to provide constant support for hot piping in power and chemical plants and in nuclear-atomic operations. They permit expansion and contraction of piping systems, through heating and cooling cycles, without developing dangerous stresses. Nine frame structures are available. Load capacities are from 31 to 32,267 lb.

The line offers increased supporting forces or greater travel within a given frame size to provide any load or travel customer may need. To simplify erecting new piping, stops are provided to lock the hanger in a fixed position. These stops are also used during hydrostatic tests. Request details.

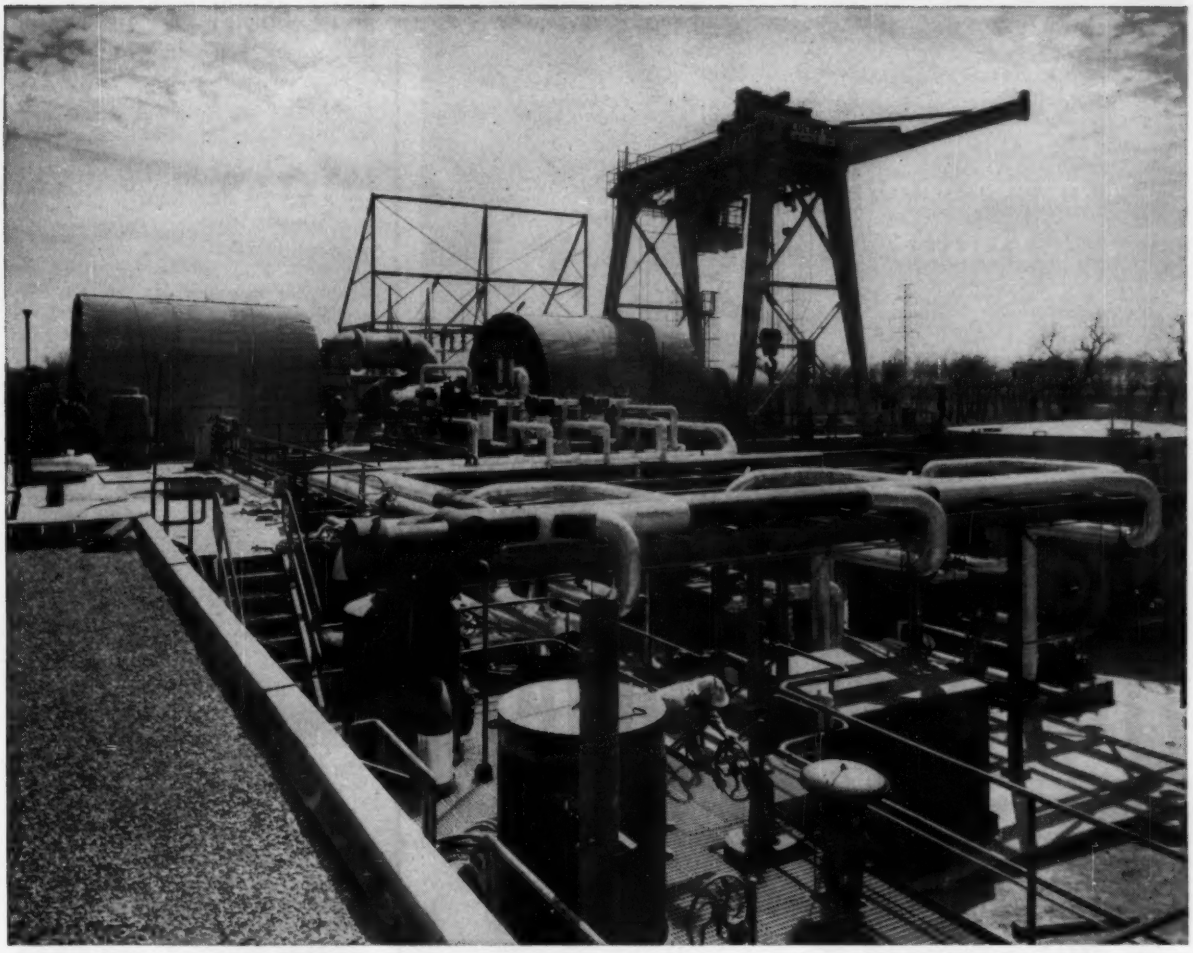
Grinnell Co, Inc, 260 W Exchange St, Providence, R. I.

For more data on these items, use post cards p 169. Identify your request with item number.



Welding-head beam carriage

228 • New beam carriage, for use with company's *Model ASM-5D* and *ASM-5T* automatic welding head, is driven by a 110-volt dc motor through a double worm gear reduction mounted in a gear case. A set of spur gears mounted between the gear reducer output shaft and the carriage drive shaft provides two travel speed ranges. By interchanging two gears, travel speed can be changed from one range to the other. Low speed range is 8 to 75 in. a minute;



Note boiler feed piping, some covered with aluminum—turbine on left, generator on right enclosed in temporary sheds

BLAW-KNOX piping serves modern outdoor Parkdale Power Plant

More than 36,000 feet of piping, in sizes from ½" to 24", are required for operating the 100,000 kw #2 unit in the new modern outdoor Parkdale Power Plant of the Dallas Power & Light Company.

Part of the system consists of 830 feet of heavy alloy steel piping—1¼% chrome and ½% molybdenum—to carry main steam at a pressure of 1550 psi and a temperature of 1005° F. Of this piping, 800 feet is 10¾" OD x 1.563" wall thickness and 30 feet is 16" OD x 2.25" wall thickness.

Piping 2½" and above was shop fabricated by the Blaw-Knox Power Piping Division in Pittsburgh. Piping 2" and under was field fabricated. All of it was erected by Blaw-Knox, who maintained a supervisor on the site.

The designers and supervisory engineers for all construction were Ebasco Services Incorporated. Blaw-Knox was the prime piping contractor.

Always available to you are the same experience, skill and facilities of our Power Piping Division. Let us know your requirements and we'll provide the service you need.

To get more information on piping for industry, send for your copy of Bulletin No. 2443.

BLAW-KNOX COMPANY

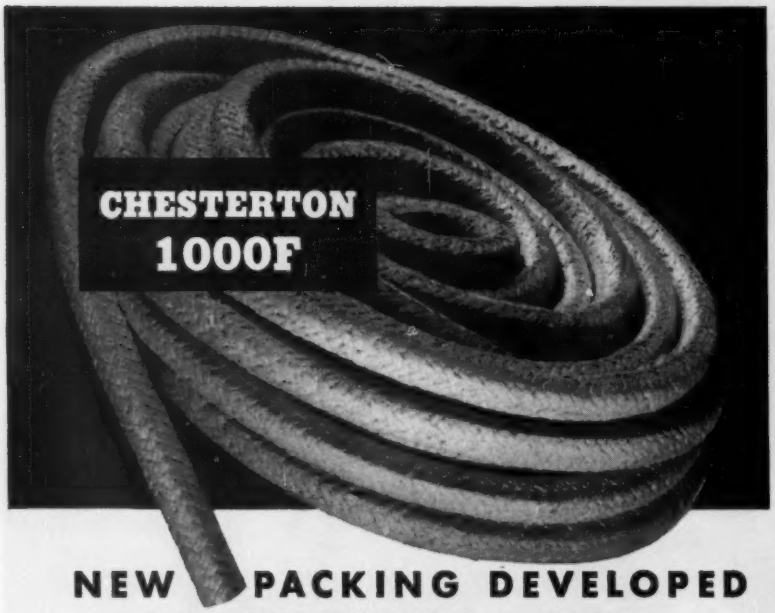
Power Piping and Sprinkler Division

Pittsburgh 33, Pennsylvania

POWER PIPING

BLAW-KNOX

Complete prefabricated piping systems for all pressures and temperatures . . . plus complete line of functional spring hangers • constant support spring hangers • rigid hanger assemblies • overhead roller assemblies • supports • vibration eliminators



NEW PACKING DEVELOPED BY CHESTERTON FOR

1000° fahrenheit

Chesterton *Style 1000 F* is a newly developed, thoroughly tested, steam valve stem packing for pressures up to 1500 lbs. and heats to 1000° F. Chesterton *1000 F* is successfully in service under these severe conditions on stationary and throttle valves.

Chesterton *1000 F* is a revolutionary new packing development in which new materials and lubricants are combined to produce a new high standard in heat and pressure resisting service. In Chesterton *1000 F* an indestructible asbestos yarn containing 95% long fiber asbestos is combined with high tensile strength, fine filament monel insertion. The packing is lubricated with a scientifically developed white lubricant designed to function at highest pressures and temperatures.

Chesterton *1000 F* will not boil out or shrink, will not pit stainless steel stems, will not grow hard and requires no take up. It has good compressibility as well as excellent recuperative characteristics.

If you are not getting typical Chesterton *1000 F* satisfaction under severe conditions, we invite you to try this packing. Order directly from us or through any local Industrial Jobber. Only necessary to specify Chesterton Style *1000 F* and the size required.

PACKING Chesterton SERVICE

A. W. CHESTERTON CO. • EVERETT 49, MASS.
America's Oldest Manufacturer of Mechanical Packings

MORE EQUIPMENT NEWS

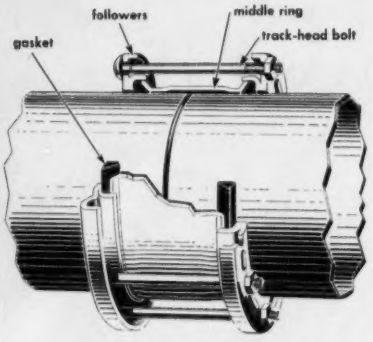
Begins on page 160

high speed range is 75 to 300 in. a minute.

A friction roll, held against the back rail of the beam by a spring, propels the carriage on six permanently lubricated, sealed rollers. When crank to left of control panel is pulled down it disengages drive roll and simultaneously raises welding head so carriage can be positioned manually.

Unit can be equipped to perform submerged-arc, inert-gas or open-arc welding. When equipped to do inert-gas welding, solenoid valves are supplied to control the flow of gas and cooling water.

Hobart Brothers Company, Hobart Square, Troy, Ohio



Abrasion-resistant piping

216 • *Ashcolite* metal pipe with sleeve couplings and a complete line of piping accessories is designed for hydraulic or pneumatic materials-handling systems.

Piping arrangements are made from sections of plain-end pipe joined by a gasketed sleeve coupling, illustration above. Adaptors, similar in design to the sleeve coupling, are used to connect pipe to flange assemblies of all types. Other accessory items include blind flanges to close open ends of pipe runs and bend fittings specially designed to minimize abrasive wear and friction losses.

The metal is composed of a chrome-iron alloy cast by the sand-spun process. This results in pipe with hardness ranging from 280 to 340 Brinell, manufacturer states.

Standard sleeve coupling, illustration, permits quick pipe connection. When bolts are drawn up, gasket pressure against pipe produces a tight but flexible seal that permits a 4 deg angle of deflection per connection. Sections of pipe to be joined can thus be simply aligned.

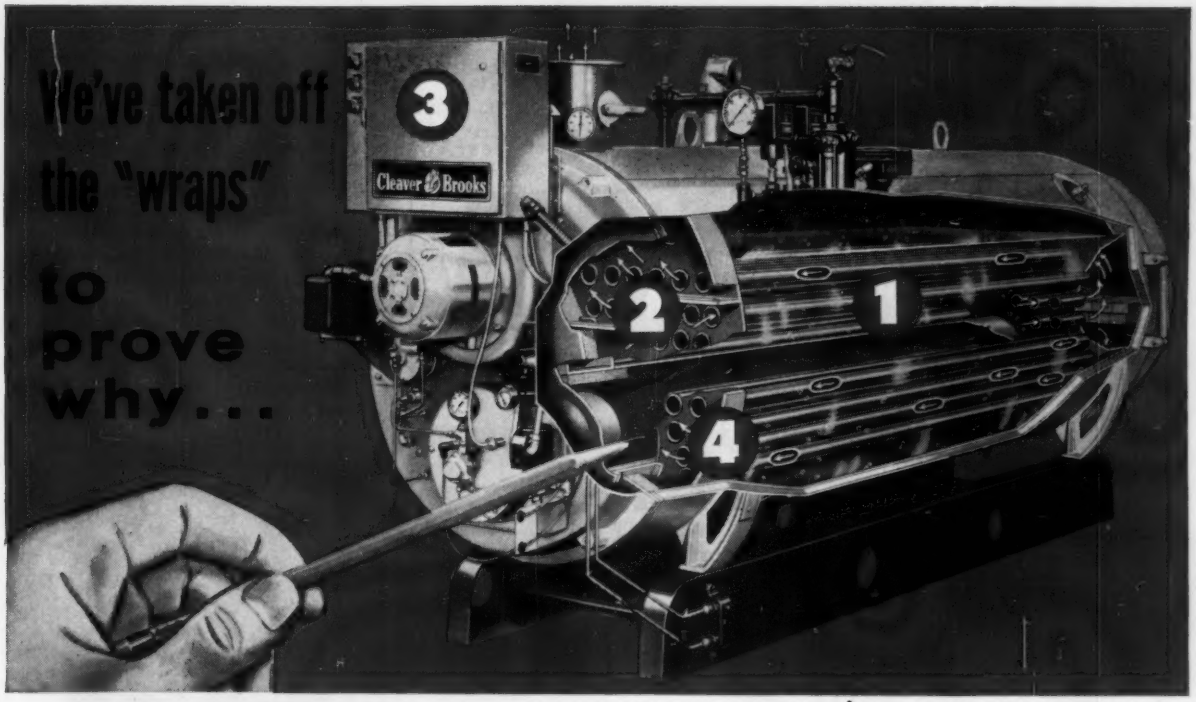
Ashcolite pipe is available in sizes from 4 to 12 in. I.D. and in lengths to 16 ft.

Allen-Sherman-Hoff Co, 259 E Lancaster Ave, Wynnewood, Pa.

For more details on these items, use post cards p 169. Identify your request with item number.

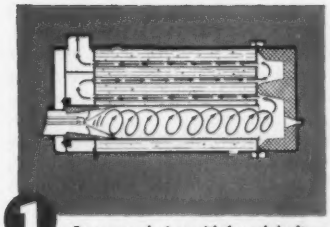
Improved power cylinders

224 • Among new features adopted as standard specification for company's air and hydraulic cylinders are: (1) Case-hardened, chrome-plated piston rods, claimed to be practically immune to dam-

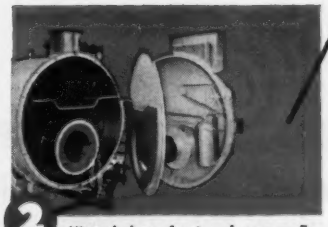


CB is America's most modern boiler

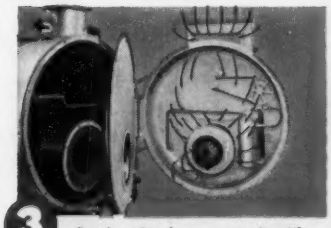
unmatched in performance quiet operation low-maintenance



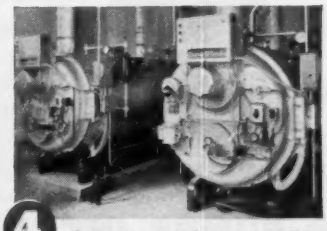
1 **Four-pass design with forced draft —** Proved the most efficient combination to transmit greatest percentage of heat to boiler water. Blower provides cool, clean air in required density and volume for efficient fuel combustion — lowers fuel costs.



2 **Hinged doors front and rear —** Expose tubes for quick inspection or cleaning. Operating equipment and refractory stays intact. Cuts routine maintenance from hours to minutes. Doors are gasketed with preformed asbestos to be seal-tight.



3 **Caseless fan keeps operation "hospital quiet" —** Air is drawn into a large plenum chamber which confines and deadens air noises. Even at peak loads, CB is well within requirements for low sound levels where this is a factor.



4 **Automatic controls are centralized for convenience, efficiency and safety —** Air is metered with oil (or gas) in proper ratios to economize on fuel. Electronic flame failure control is standard equipment.

CB boiler's remarkable performance in hundreds of applications has proved an "eye-opener" wherever installed. Take a minute's time and see why.

Combined into one boiler package are all the features *proved necessary* to: (1) save fuel dollars, (2) simplify maintenance, (3) assure silent performance, (4) maintain safe, automatic operation.

Talk to your nearby Cleaver-Brooks boiler representative — he can assist you in selecting the proper unit from a complete line of sizes, steam or hot water, 15 to 250 psi. Or, write direct for literature. Cleaver-Brooks Company, Dept. B, 300 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. Cable Address: CEEBEEWEST — all codes.

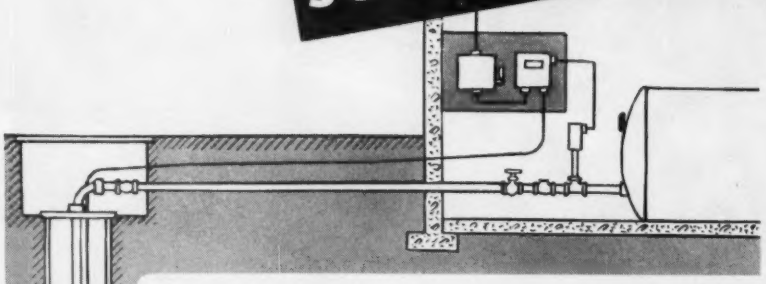
BOILERS—STEAM OR HOT WATER—FOR HEATING OR PROCESSING, IN SIZES 15 TO 600 HP, 15 TO 250 PSI.

Cleaver Brooks®

TWENTY-FIVE YEARS OF LEADERSHIP
BY THE ORIGINATORS OF THE SELF-CONTAINED BOILER

A New Lift for plant water supply needs!

THE COMPACT, HIGH-CAPACITY
SUMO SUBMERSIBLE



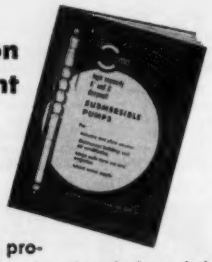
Here's a commonsense pump for any plant that depends on a deep well water supply. The SUMO SUBMERSIBLE employs a time-tested design backed by over 30 years experience in the manufacture and application of submersibles, exclusively.

Pump and motor — coupled together as a unit — operate inside the well, underwater. No pump house is needed.

Water delivery is obtained by *pushing* — not by suction. Since the water is under pressure, there are no priming problems. Shaft alignment troubles, common to pumps in which the motor is surface mounted, are eliminated.

What's more, the SUMO SUBMERSIBLE can be quickly, easily and economically set deeper to compensate for receding water levels.

Information every plant engineer should have . . .



Bulletin B-1000 provides a comprehensive description of the SUMO SUBMERSIBLE PUMP—and its many advantages as a basic water supply pump for industry.
WRITE FOR YOUR FREE COPY.

SUMO PUMPS INC.
Dept. 2 Box 983
STAMFORD, CONN.

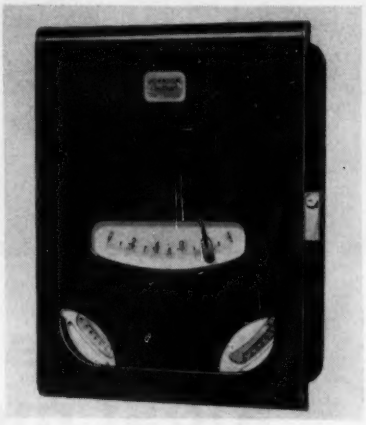
Sumo **SUBMERSIBLE WATER SUPPLY PUMPS**
Sold and serviced by leading pump distributors.

More EQUIPMENT NEWS

Begins on page 160

age from accidental hammer blows, mishandling, etc.; (2) Teflon rod wipers and Teflon hydraulic rod seals, said to withstand temperatures from –100 to 500 F and to be impervious to most chemicals including fire-resistant, special and standard hydraulic fluids in current use; (3) Black oxide finish that provides rust protection in air-cylinder operation and on all cylinders during shipping and installation. This finish is standard on cylinder heads, caps, mountings, pistons, followers, tie rods, and unplated portions of the piston rods.

Miller Fluid Power Co, 2040 N Hawthorne Ave, Melrose Park, Ill.



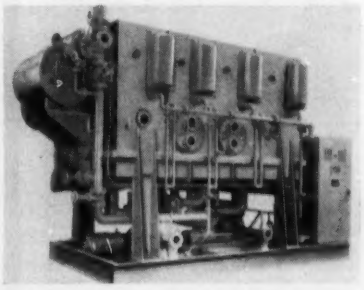
Static pressure controller

230 • Instrument controls dampers and other devices for maintaining static or differential pressures. It can be used for pressures above or below atmospheric, or for maintaining a constant differential between two pressures.

Available with calibrated dials for pressure ranges of 0 to 0.2, 0.3, 0.4, 0.5, 1.0, 2.0, 4.0 and 6.0 inches of water. Request bulletin R-1051 for full details.

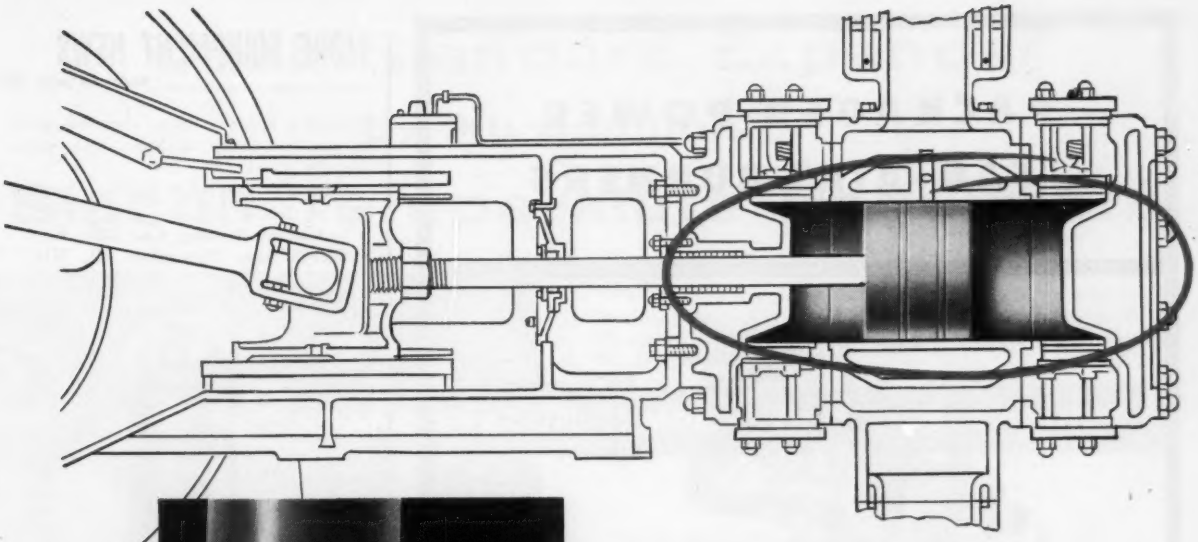
Johnson Service Company, Milwaukee 1, Wis.

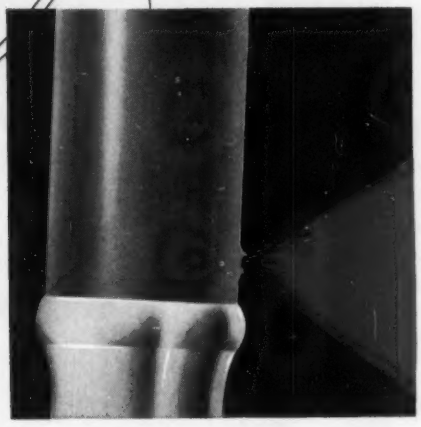
For more data on these items, use post cards p 169. Identify your request with item number.



Waste-heat evaporators

218 • Fresh, pure water from sea water at the cost of 33c for 1000 gallons is possible with these waste-heat evaporators, according to manufacturer. Utilizing waste heat from ship's diesel engines, the evaporator in effect raises diesel efficiency from





prevention

at the points

where

fires start . . .

Fire-resistant Celanese* Cellulubes*

Synthetic lubricants and power transfer fluids are now available in 6 controlled viscosities

Celanese Cellulubes are fire-resistant synthetic oils, designed to provide protection against fire hazards and explosion inherent in many industrial operations.

As air cylinder lubricants in compressed air systems, Cellulubes prevent the formation of excessive carbon deposits—No. 1 source of compressor fires and explosions. They are excellent lubricants—highly stable, non-corrosive, non-foaming.

As the hydraulic fluid in diecasting and similar critical operations, Cellulubes reduce the ever-present danger from uncontrollable fires due to line breaks or other failures. Chemical compounds that contain no additives, Cellulubes' physical properties are exceptionally stable under continuous duty.

6 CONTROLLED VISCOSITIES

With the expansion of the Cellulube series to 6 controlled viscosities: 90, 150, 220, 300, 550, and 1000 (S.U.S. @ 100° F.), the way is open to replace flammable fluids in many hazardous applications. If you would like to evaluate Cellulube in your own operation, use coupon below to order working samples and complete use data. Celanese Corporation of America, Chemical Division, Dept. 597-B, 180 Madison Ave., New York 16, N. Y.

Celanese* CHEMICALS

*Reg. U.S. Pat. Off.

Celanese Corporation of America, Chemical Division, Dept. 597-B, 180 Madison Avenue, New York 16, N. Y.

Please send me working sample and technical bulletin on Cellulube for air compressor service____ for hydraulic systems____. Send technical representative____.

Name_____

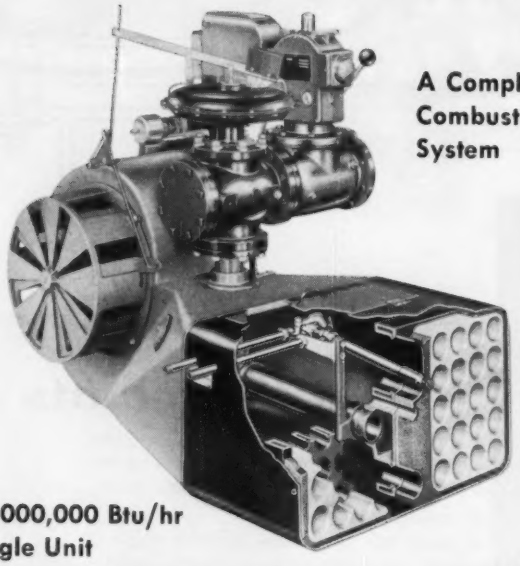
Title_____

Company_____

Address_____

City_____ Zone____ State_____

PACKAGED POWER "FAN-AIR" BURNERS



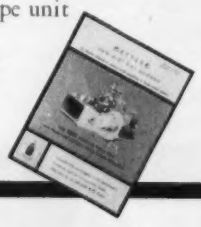
A Complete Combustion System

25,000,000 Btu/hr Single Unit

- Completely packaged . . . nothing else to buy or install
- Tested and adjusted for jobsite conditions prior to shipment
- Smooth, noiseless combustion with minimum excess air
- Wide turndown range with no danger of flashback
- More uniform and effective heat distribution
- Natural draft operation during power failures
- Least expensive installation
- Requires less stack and furnace draft
- Built to exceed standards of all approval agencies
- Complete burner shutdown following flame failure
- Mettler patented spark-ignited rectifier safety pilot, with dependable electronic flame safety relay
- Available with steam, pressure, or air atomizer for burning heavy oils in combination-type unit

Write for new Catalog and Specifications

Bulletin G-200-B describes exclusive "Fan-Air" features, accessories, pilot operation, and major specifications of burners ranging from 400,000 to 25,000,000 Btu input. Write for copies, today!



METTLER

Eclipse

THE METTLER CO., INC.

Division of ECLIPSE FUEL ENGINEERING CO.

4366 Worth Street, Los Angeles 63, California

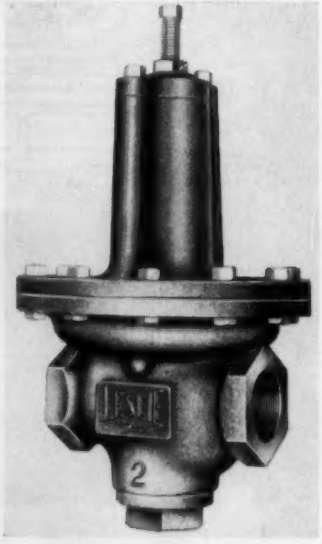
MORE EQUIPMENT NEWS

Begins on page 160

30 to 60% in producing an abundant source of pure water for shipboard uses, manufacturer states.

Units are expected to find wide application on offshore drilling rigs.

Cleaver-Brooks Co, 326 E Keefe Ave, Milwaukee 12, Wis.



Water-pressure reducing valve

219 • Valve features, claimed by manufacturer, include (1) large bowl construction and long travel diaphragm that gives full flow (2) fully balanced construction for smooth throttling action (3) high strength balancing diaphragm to eliminate less positive seals and (4) renewable trim with interchangeable fit.

Units designated *Hi-Flo* valves, are available in ½ through 2-in. compound-treated cast-iron bodies. Inlet pressure range is 10 to 250 psi, 180 F with reduced pressure ranges of 5 to 30 psi or 25 to 80 psi. Minimum pressure drop is 5 psi.

Leslie Co, 225 Delafield Ave, Lyndhurst, N. J.

For more data on these items, use post cards p 169. Identify your request with item number.

Spherical union connection

223 • Spherical union connection for valves is said to compensate for up to 10-degree misalignment of vessel tappings in any direction from perpendicular axis and a wide variation in centers.

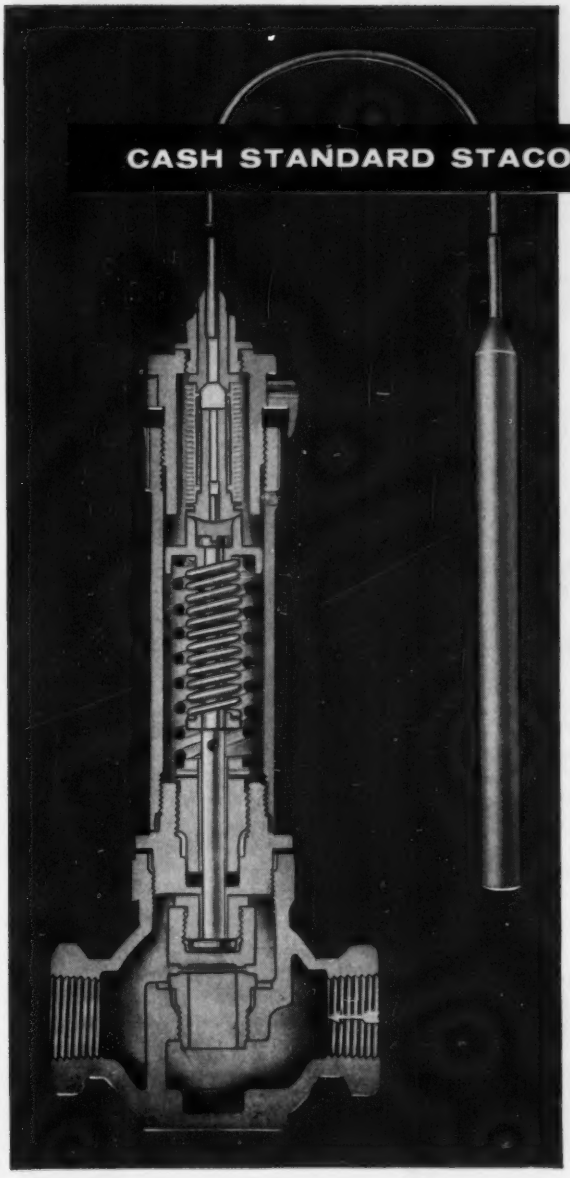
When used with a side-connected gage, unit on the tank connection side of valve alone will permit variation of plus ⅜ to minus ⅜ in. per valve or a total of ¾ in. increase or decrease on centers. For example, a gage having side connections of 20 in. could be installed on tank centers anywhere from 19¼ to 20¾ in. using straight valves with spherical union tank connections. Complete details available on request to the manufacturer.

Jerguson Gage & Valve Co, 80 Fellsway, Somerville 45, Mass.

Cash Standard Expands

by the addition of

Stacon Temperature Regulators

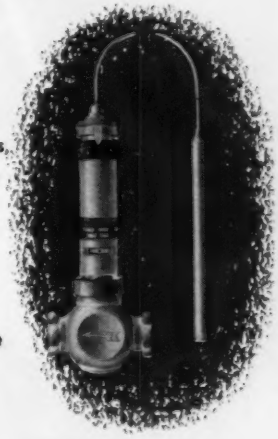


This line of temperature regulators (formerly manufactured by Farris Stacon Corp.) rounds out complete Cash Standard line of valves to solve any problem of temperature regulation or pressure control.

CASH STANDARD STACON TEMPERATURE REGULATORS

- Provide accurate temperature control for use with steam, liquids and gases.
- Self-operating and self-contained pilot-operating.
- Direct and reverse acting.
- Liquid filled thermal system for high operating power and uniform throttling action.
- Extremely compact construction with rugged field-replaceable thermostatic system.
- Overload protection to prevent overstressing of thermostatic system at over-range temperature.

Recommended for hot water heaters, tanks, kettles, plating tanks, bottle and can washers, degreasers, ovens, fuel oil heaters, brine circulating, process cooling, jacket cooling for compressors, diesel and gas engines, and many other uses.



What is *Your* Temperature Regulation Problem?

Cash Standard has the Answer!

Contact your Cash Standard control specialist or write Dept. E.

CASH STANDARD

A. W. CASH COMPANY, P. O. Box 551, Decatur, Illinois

Pressure, Hydraulic, Temperature, Process and Combustion Controls

BELMONT CRISS CROSS BRAID

"Greatest braided packing advance in history"

MADE IN

White and Blue African Asbestos

•

TEFLON-impregnated Asbestos

•

Pure TEFLON

NEW DESIGN, CONSTRUCTION

Each strand runs diagonally through the packing body at a 45° angle, unifying all strands into one interlaced packing structure with uniform controlled porosity.

WON'T RAVEL,

slough off or wear through, and its solid, integral braid gives greater flexibility without distortion in ring forming.

LUBRICATION "LOCKED-IN"

by the crisscross braided structure.

LONGER SERVICE LIFE

is your premium for selecting this stronger, longer wearing, better lubricated packing.

Ask your U. S. Gasket-Belmont Packing Distributor or write for literature.

The Belmont Packing & Rubber Co.
Butler & Sepviva Sts., Phila. 37, Pa.

U.S. GASKET • BELMONT PACKING

FOUR CHARTS

Continued from page 88

Displacement, speed. On the first chart connect S with the compressor speed, rpm, and read the mean velocity of the piston C_m at the intersection. Thus with a stroke of 1.5 in. and a speed of 500 rpm, $C_m = 2.07$ fps, as shown by the dashed line.

To find the displacement, cu in. per stroke, connect S with the piston area, sq in., and read the displacement per cylinder per stroke V on the second scale from the left. To find the displacement per hour, connect the point on V with the compressor speed, rpm, and read the result at the intersection with the V_s scale.

Volumetric efficiency of refrigerating compressors can be found from the second chart when the ratio of the clearance volume S_o to the cylinder volume S is known, as well as the specific-heat ratio of the refrigerant c_p/c_v. For instance, with a suction temperature of –13 F and a condensing temperature of 77 F, the ratio of the absolute values of these temperatures, $T_1/T_2 = 1.20$. This is found by projecting from t_2 through t_1 to T_1/T_2. Next, project from S_o/S for the particular compressor, and from c_p/c_v, for the refrigerant as shown. Then project from T_1/T_2 through the point on the auxiliary line to the total volumetric efficiency, expressed as a decimal.

Note that the point on the auxiliary line is found by projection from the compressor and refrigerant characteristics; c_p and c_v are the specific heats of the refrigerant at constant pressure and constant volume, respectively.

Room surface area, important in heat loss or gain computations, can be found from the third chart. Simply enter at the left at the room volume, cu ft, and project through the proper shape factor. Read the total surface area of the room, including floor and ceiling, at the right.

In the example shown, a room with a volume of 630 cu ft has an over-all surface area of 460 sq ft if it is twice as long as it is high and wide.

Log mean-temperature difference, often used in heat-transfer problems, is given by our fourth chart. To use, the initial and final temperature differences must be known. These should be computed from the physical arrangement and flow conditions of the apparatus being analyzed.

To use the chart, project from the initial temperature difference on the left to the final temperature difference on the right. Read the log mean-temperature difference on the central scale.

J. S. PRODUCTION UP 10% WITH . . .

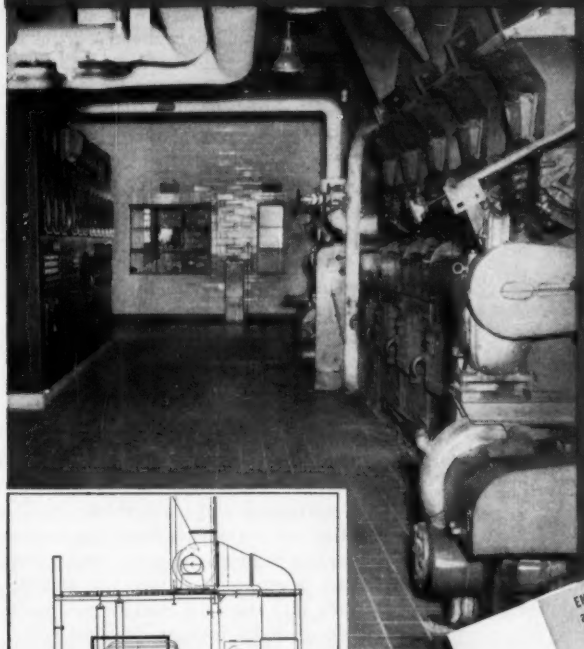
DETROIT ROTOGRATE STOKER

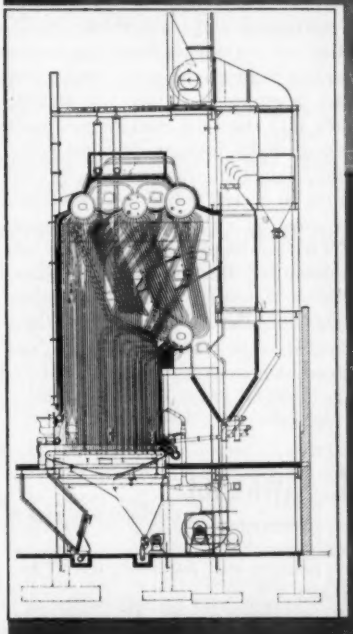
John Strange Paper Company, Manasha, Wisconsin Wins Power Modernization Award With New Steam Plant

• • •

Because so much steam is needed in paper making, the improved efficiency is reflected in a 10% increase in paper production. Since many costs remained the same, extra profits may be credited to the new steam generating equipment.

This includes a Union Type B four drum steam generator with superheater and economizer, fired by a Detroit RotoGrate Stoker. Capacity 165,000 pounds of steam per hour at 725 pounds pressure, 825° F temperature.





ENGINEERING and MANAGEMENT SECTION
John Strange Paper Co's modernized power plant is an outstanding example of . . .
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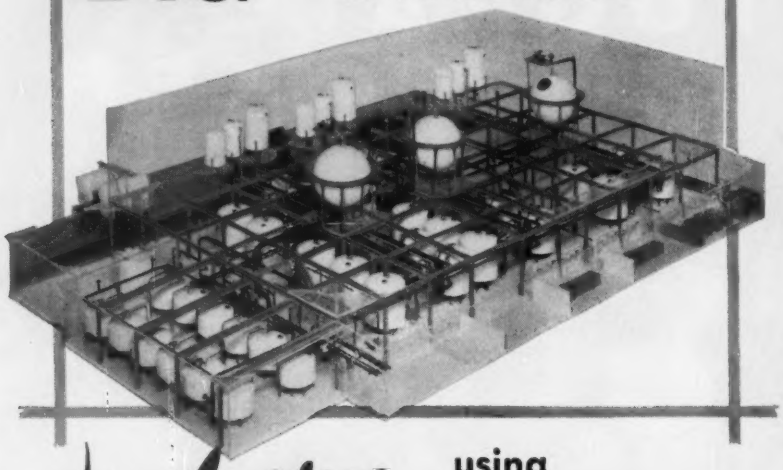
Model of

BIG DEMINERALIZER EFFICIENCY



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BUILDING and operating a giant demineralization plant, like the one shown in model form above, are most impressive achievements. Unseen, yet vital, are the materials for which the whole plant is designed: the ion exchange materials used.

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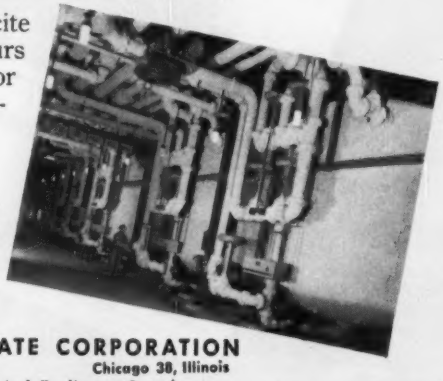

The model grows up. Section of demineralizer plant modeled above—one of world's largest—showing some of automatic control features.

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Nalco

When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.

WATER SOURCE

Continued from page 91

tity of water, it is usually not economical to apply much water treatment to once-through systems. Screening, with possibly filtration and intermittent chlorination are usually all that can be justified. Because the water is not concentrated, the tendency for solids to deposit out as scale is minimized. Corrosive tendencies have to be combatted mostly with materials of construction or protective coatings.

In a closed recirculating system where water is not exposed to air or evaporation, corrosion is the chief problem. Various chemicals and proprietary preparations are available to make the water noncorrosive. Chlorination or occasional cleaning prevents algae deposits that might slow heat transfer or restrict water circulation.

In an open recirculating system where evaporation is used for cooling, either corrosion or scale may become a problem. Oxygen accentuates any tendency to corrosion, and also causes iron in the water to deposit out. Evaporation increases solids concentration in the water. So scale formation on heat-transfer surfaces is often a problem.

But you can usually make this system operable in large-size units, even where water is relatively scarce. Use makeup water that does not contain too many scale- or sludge-forming dissolved solids. Also, maintain concentration in the system at a safe value by blowdown, and possibly with chemical treatment.

Next installments of this series will go into the different water-treatment methods—screening, settling or subsidence, coagulation, filtering, aeration, chlorination, softening, distillation, and cation-anion exchange.

ST. LAWRENCE

Continued from page 76

each country will purchase, install and operate.

Development power. All water in International Section of the St. Lawrence has not all been running to waste. For many years St. Lawrence River Power Co has operated a 100,000-hp plant on the Grass River near Massena, N.Y., taking water from above Long Sault Rapids through a canal, Fig. 2. This plant generates on the average 545-million kwhr annually, which is supplied to the Messena works of Aluminum Company of America. These works use about 2.5-billion kwhr per year, which is about 40% of New York

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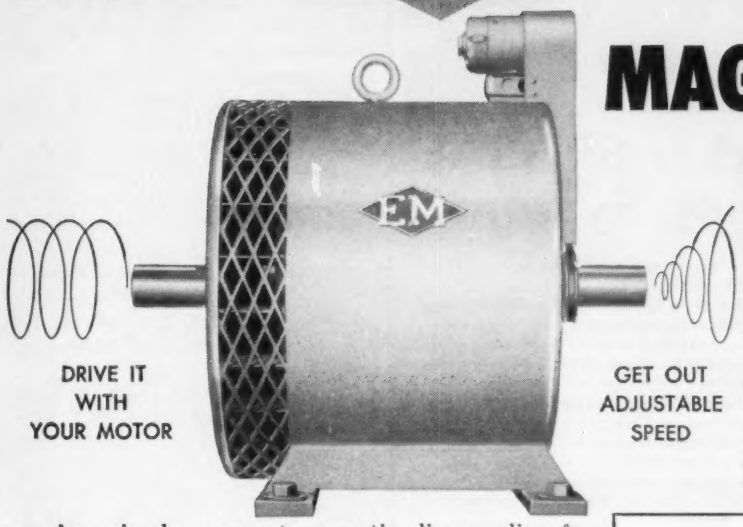


EASILY ADAPTED—Ampli-Speed may be either belted or coupled to your motor (or other drive) as well as to load.

SIMPLE TO INSTALL—Air-cooled Ampli-Speed can be handled and installed like a motor.

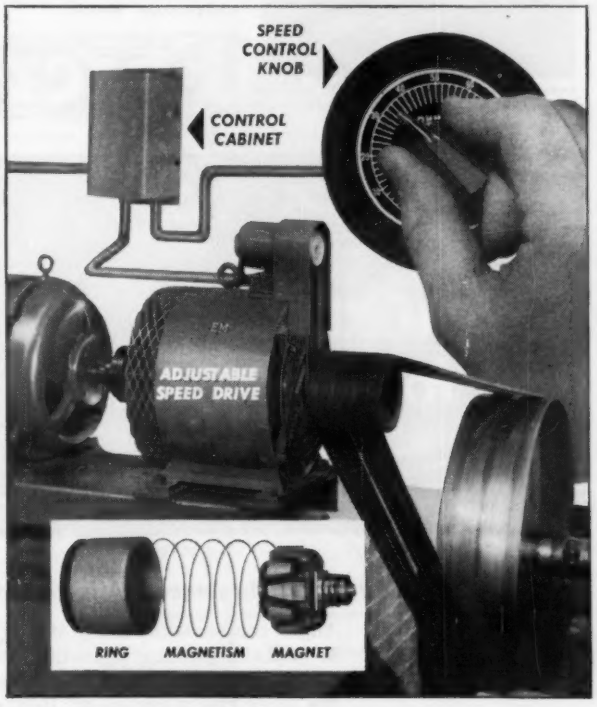
EASY TO CONTROL—Speed changed by simply turning control potentiometer . . . output may be controlled automatically by pressure, level, or combustion devices.

HERE'S a simple, compact magnetic slip coupling for use with an existing motor to get advantage of precise adjustable speed. It's designed for fans, pumps, and centrifugal compressors, or constant torque loads such as conveyors, mills, mixers, chain grate stokers, plasticators, and many more. Whatever the drive, you have perfect control of load speed, nearly stepless speed change, and output speed held within close limits of control knob setting.

HOW IT IMPROVES OPERATIONS IN YOUR PLANT

1. Provides exact speed for desired rate, pressure, or flow — eliminates "margin of error" inherent in constant speed drive systems, giving accurate control for literally hundreds of jobs.
2. Maintains preset speed in spite of moderate changes in load, line voltage, or frequency. Fast, accurate response — no overshooting or hunting.
3. Cushions load shocks . . . minimizes vibration between motor and load . . . assures smooth, steady power.
4. Permits motor starting with low kva inrush (on reduced voltage), if necessary. After motor has reached proper speed, Ampli-Speed smoothly starts load.
5. Cuts cost of fan operation . . . requires much less power to drive fan at part speed with Ampli-Speed than it does to drive fan against dampers at full speed. Also minimizes fan blade erosion where abrasive particles are present.
6. Makes pumping units more efficient . . . eliminates wasteful throttling, which increases head as it decreases output.

You'll find E-M Ampli-Speed Magnetic Drive has almost unlimited application . . . contact your nearest E-M sales engineer for full information. And write the factory for E-M Ampli-Speed Bulletin 229P.



Three units make up the Ampli-Speed system: Adjustable Speed Drive between motor and load; wall-mounted Control Cabinet; and Speed Control Knob mounted at any convenient location, putting precise speed control right at your finger tips! Output speed depends on magnetic attraction between ring and magnet members. Amount of attraction, and thus speed, is controlled by changing d-c excitation to vary magnet member field strength.

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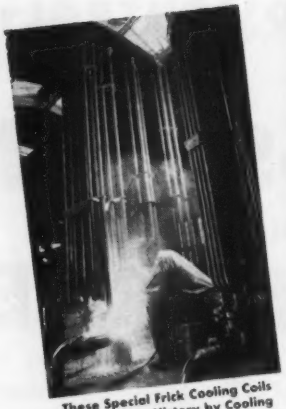

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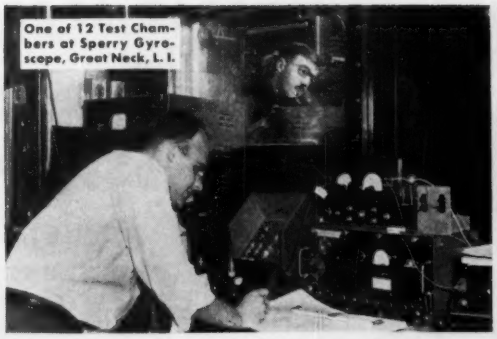

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ST. LAWRENCE

Continued from page 196

State's share of St. Lawrence River power.

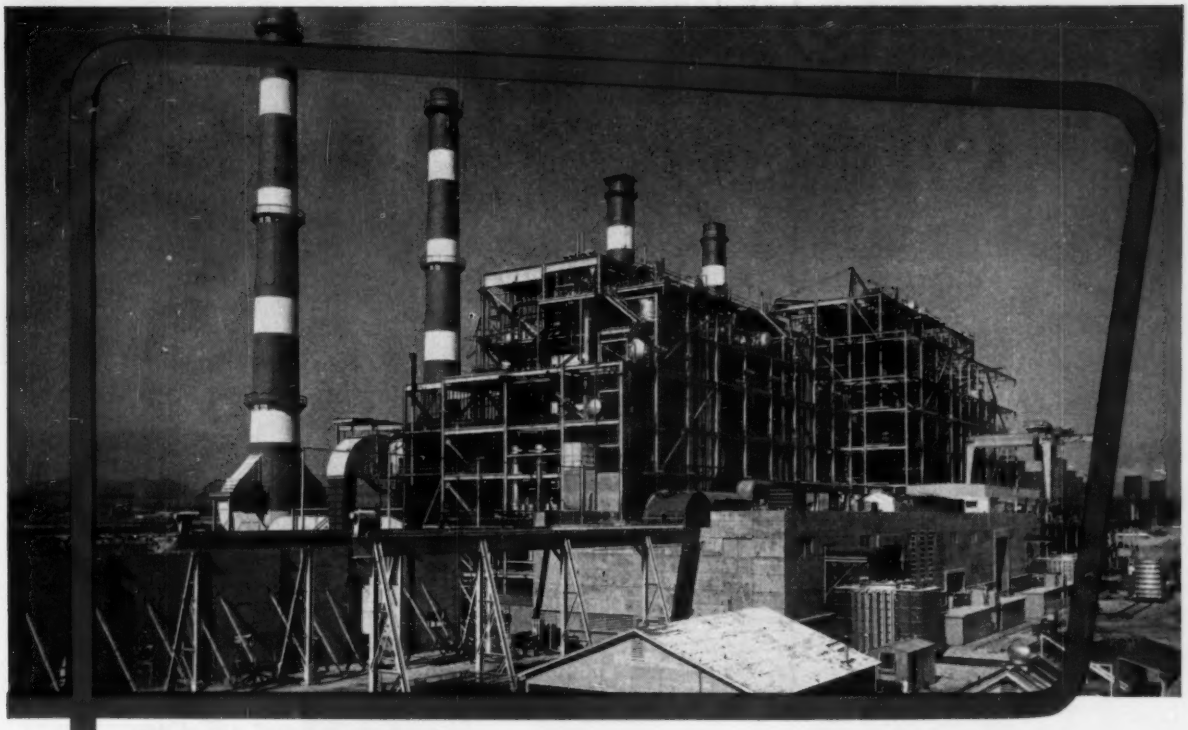
Iroquois dam. Fig. 4 shows International Section of the St. Lawrence River where the power development is being made. Included in the project are Iroquois, Long Sault dams and the powerplant, which forms a third dam. A natural rock weir below Ogdensburg, N.Y. now controls outflow from Lake Ontario to hold its surface between 242.5 and 249.5 ft above sea level, a variation of about 7 ft. Artificial control will replace this natural weir (1) to provide greater operating flexibility of the project (2) to protect all lake front and river interests against changes in water level that might cause damage or inconvenience to property owners and (3) to secure maximum dependable annual flow for power generation.

To do this a control dam is being built at Iroquois Point about 7 miles below the natural weir and 25 miles above the powerplant. It will be a buttressed gravity concrete structure, curved upstream—about one half its length being in Canada and the other in the U.S. A spillway in this dam, with 32 vertical lift gates handled by either of two 225-ton gantry cranes, will regulate flow from the lake to maintain its level at elevation 244 to 248 ft above sea level. This is within a range of 4 ft, compared to 7 ft during natural flow.

Concrete gravity sections will flank the sluiceway at each end, with the remainder of the valley closed by rolled-earth wing dams. Water released from this dam will flow directly to the powerplant forebay.

Long Sault dam. About six miles above Cornwall, Ont. the St. Lawrence divides and flows around Barnhart Island in Long Sault Rapids. Of the 93-ft fall in International Section of the river about 60 ft are in these rapids. Long Sault or main dam connects the west end of Barnhart Island with the U.S. mainland. It will close the south river channel and be entirely in the U.S. This dam is mainly a concrete-gravity spillway, 3000 ft long, 145 ft high above the low point in the foundation. It will raise the water level about 90 ft above river bottom. It will be flanked by short sections of concrete bulkheads, earth wing walls and an earth dyke. On the crest of the spillway will be 31 vertical-lift gates, 50x29 ft. These will closely regulate forebay water elevation by discharging any water that cannot be used for power generation. A 260-ton and a 170-ton gantry crane, to be installed on dam, will handle the gates.

Powerhouse will extend from the east



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Answering the need for extraordinary strength and endurance, KEY-KAST specially designed wyes have been installed in the main steam lines at the Valley Steam Plant Unit #4, City of Los Angeles, Department of Water and Power. The dependable performance of KEY-KAST wye fittings is achieved through careful engineering and special emphasis on:

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SPECIAL NOTE: We invite your inquiries for main steam wyes, laterals, elbows, etc. In submitting your inquiries, please list design temperature pressure conditions, pipe or tube schedule or wall thickness and material.

Pipe fabrication in this modern West Coast power plant by Associated Piping & Engineering Co., Inc.

JOB DETAILS

FITTING:	14"x12"x12" 120° wye
MATERIAL:	2¼% chrome, 1% moly. Grade WC9
DESIGN CONDITIONS:	1925# @ 1000°F.

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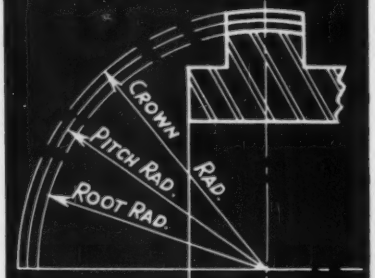
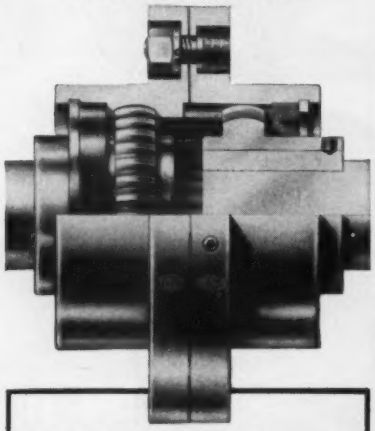
DIFFERENCE
TEETH ARE CUT



ON A TRUE ARC

SPHEREFLEX®
COUPLING



SPHEREFLEX tooth design features an exclusive curved root and spherical tooth flank. Both angular and linear (parallel) misalignment are compensated for, since every portion of each gear tooth is actually a segment of a sphere. This special design eliminates all possibility of tooth interference and permits increased deflection between mating members. Full and uniform line contact, through the working depth of the tooth, insures a stronger coupling between driver and driven shafts; eliminates point rolling contact between gears during flexing; compensates for shaft misalignment up to 14° included angle. Send for Catalog C-560.

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Industrial Gears & Speed Reducers • LimiTorque Valve Controls
Established 1892

ST. LAWRENCE

Continued from page 198

end of Barnhart Island to the Canadian mainland. Located on the international border with one half its length in Ontario and the other half in New York State, the plant also serves as a dam across the main channel of the river. It includes a massive concrete intake structure and a semioutdoor powerhouse, Fig. 5. This two-in-one structure, 3200 ft long, spans the channel in a straight line at right angles to the direction of flow.

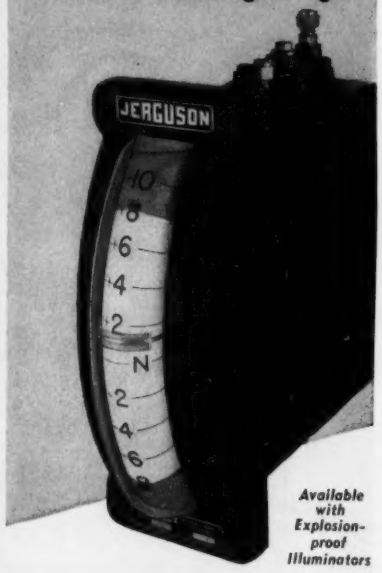
Deck of the intake structure is 162 ft above the low point of the draft tube to give a maximum head of 87.5 ft. Three gates will admit water to each of the 32 turbines, 16 in each half of the powerhouse. The powerhouse, a modified outdoor type, will not have a conventional superstructure over the generator room. Set into what amounts to wells in the concrete structure the generators are protected against the weather by removable housings.

Erection bay. At each end of the powerhouse is an enclosed erection bay over 200 ft long. Here, equipment can be assembled after an overhead crane or a 400-ton gantry has unloaded it from railway cars or trucks. After assembly the gantry, which travels the full length of the power house, picks up equipment and delivers it for installment. Both ends of the powerhouse are similarly equipped with cranes. Included is a 90-ton gantry on the headwork structure and a 30-ton unit over the draft-tube discharges.

Propeller turbines. On the U.S. side, the 16 fixed-blade propeller turbines are each rated 75,000 hp, 94.7 rpm under 81-ft head at best gate opening. At a 87.5-ft maximum head and full gate each turbine is expected to develop 89,000 hp. They connect to 60,000-kva 13,800-v generators, designed for 15% overload. Eight of the turbines are being built by Baldwin-Lima-Hamilton Corp and eight by Allis-Chalmers Mfg Co. General Electric Co. is building the 16 generators. In the Canadian end of the powerhouse the 16 fixed-blade propeller turbines, rated 75,000-hp 94.7-rpm, connect to 60,000-kva 0.95-pf generators. English Electric Co of Canada is building all 16 turbines. Eight of the generators will be built by Canadian General Electric Co and eight by Canadian Westinghouse Electric Co.

Because winter temperatures may get down to –40 F or lower, the gates in both dams and power-plant headworks are equipped to operate in extremely cold weather. Compressed-air bubbler systems will keep ice from forming on the upstream face of the dams and

Jerguson
TRUSCALE
Remote Reading Gages



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Accuracy to ½ of 1%

You get full 180° visibility with the new Jerguson Truscale Gages with the Convex Scale. Scale markings are directly on the convex face and the indicator goes clear around the convex surface. You can bring your liquid level down to the control room floor, or other remote point . . . and can see it from anywhere in the room . . . can check a whole line-up of Truscales with one look from any point.

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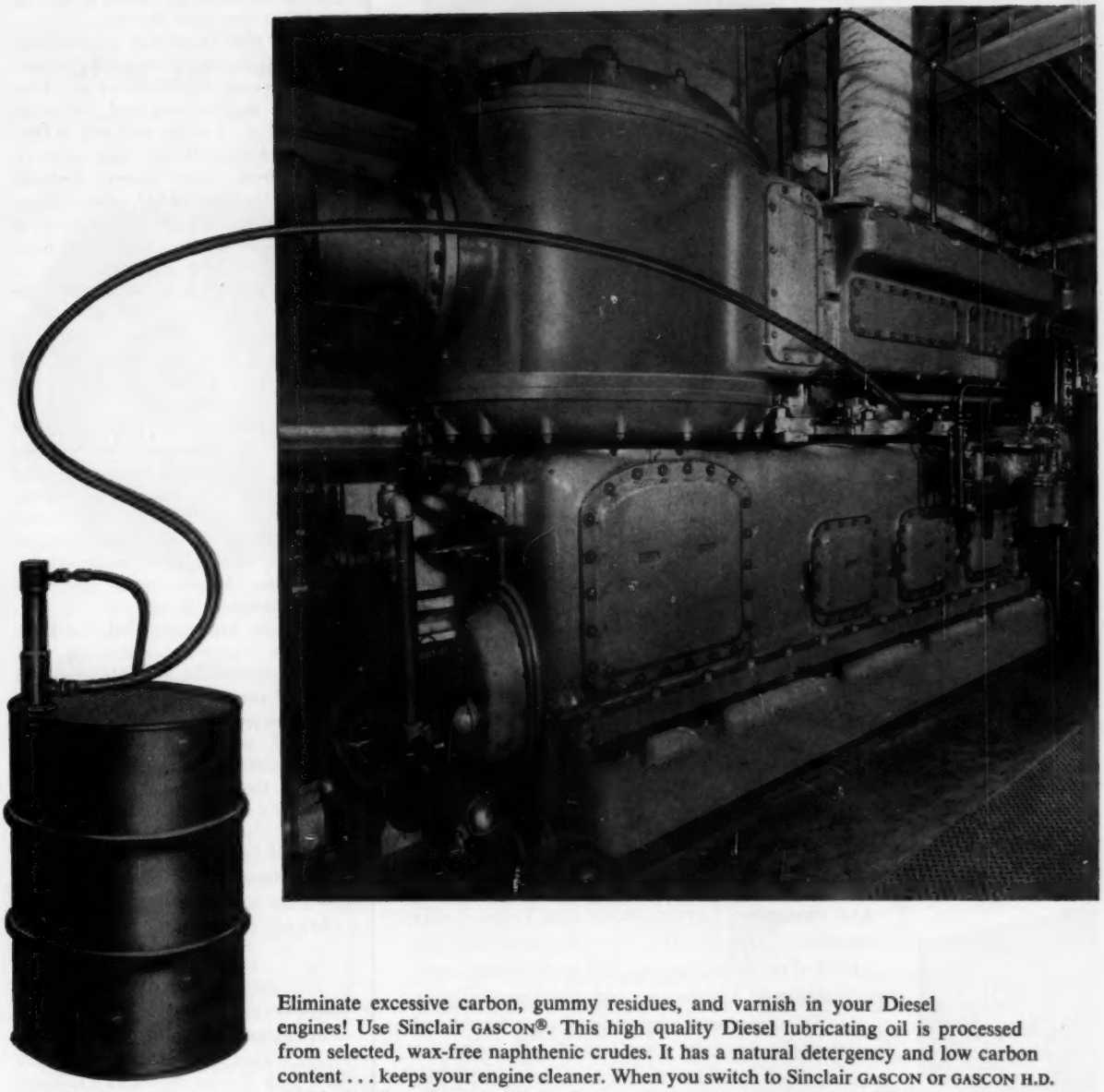
Check Carbon!



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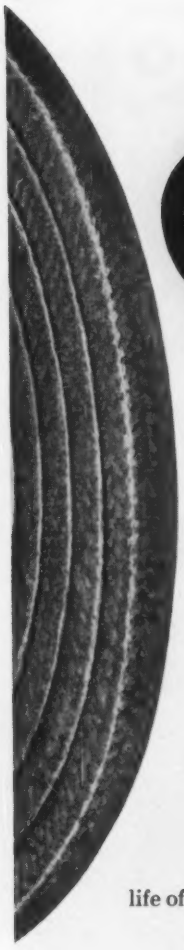
ONE OF THE GARLOCK 2,000



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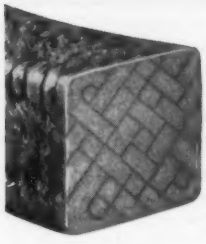
Don't take our word for the greater strength, longer life of LATTICE BRAID with Teflon—try an initial order of 10 or more feet today. The Teflon core and impregnation resist everything except molten alkali metals and some freons.



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ST. LAWRENCE

Continued from page 200

clogging the gates. These with electrically heated gate guides insure satisfactory operation at all times under any conditions that may develop.

Project size. Quantities involved may give some idea of the size of the project. Overall, about 86,000,000 cu yd of excavation will be required, including 5,000,000 cu yd of dry rock and 31,000,000 cu yd of earth and rock to be removed from under water. Embankments, cofferdams and 14 miles of dykes will contain nearly 20,000,000 cu yd of earth and rock. Dams and power plant will require about 3,000,000 cu yd of concrete, enough to build an 18-ft-wide highway, 9 in. thick, 1200 miles long.

Even though the Power Authority of the State of New York did not get final approval to build its half of the project until June 1954, the whole job is now well under way for initial operation late in 1958. Contracts have been let for most of the major construction and power equipment. This rapid progress is due in no small part to the Hydro-Electric Power Commission of Ontario, which for several years made exhaustive studies of International Section of the St. Lawrence River.

With the data assembled, the Commission's engineers constructed near Toronto three hydraulic scale models of the St. Lawrence. These models duplicate river conditions on the Canadian and U.S. sides including shore line, river-bottom contours, flow and turbulence in the flow for 35 miles of the river, As a result of these studies basic data on the river were immediately available for locating structures and base designs, as soon as the green light was given to build the project.

As previously mentioned the Canadian half of the project is being built by Hydro-Electric Power Commission of Ontario of which Dr Richard L Hearn is chairman and Dr Otto Holden, chief engineer. U.S. half is being built by the Power Authority of New York State with Robert Moses as Chairman and J Burch Mc Morran, chief engineer. Sanderson & Porter, and Uhl, Hall & Rich are consulting and design engineers.

MARMADUKE

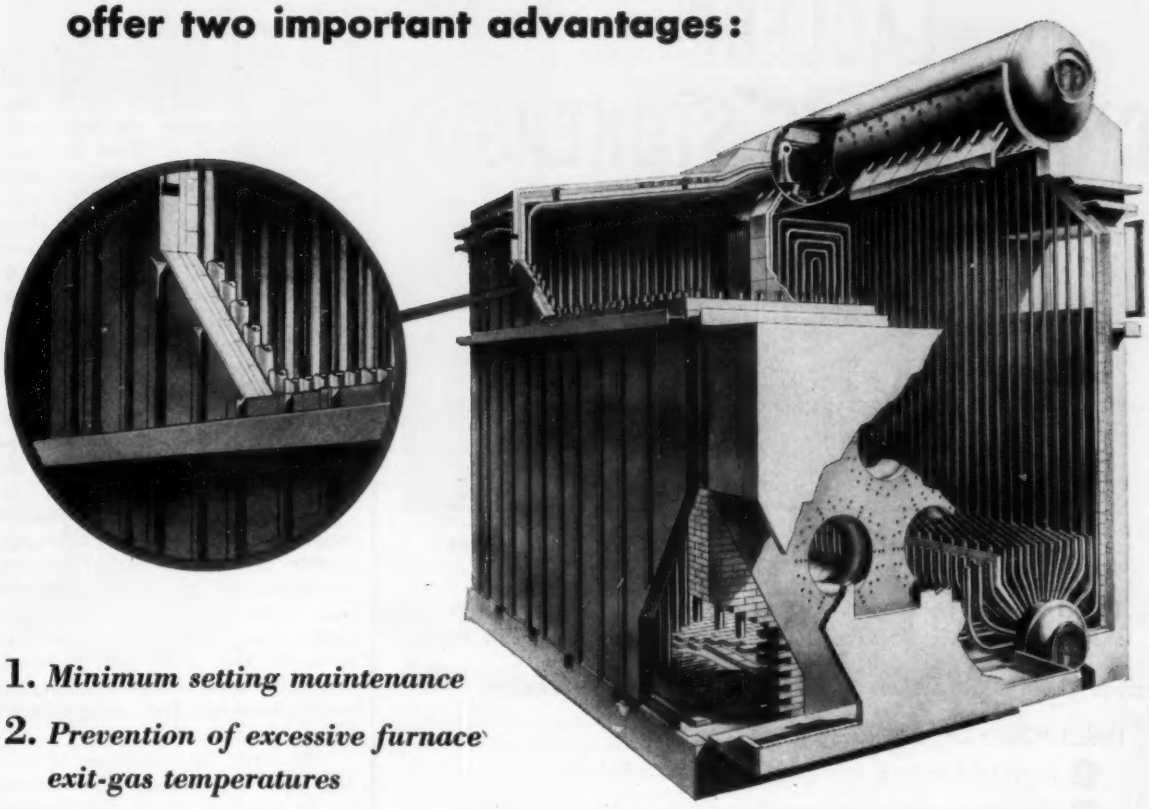
Continued from page 148

"Bilgewater on making new parts," roared the old consulting engineer in his foghorn voice, with such force that the leather belts vibrated like a plucked G string on a base fiddle. "I'll tell you about the time I got an old corliss going

Another Feature of the FW Series "SC" Standard Boiler...

COMPLETELY WATER-COOLED WALLS

offer two important advantages:



1. *Minimum setting maintenance*
2. *Prevention of excessive furnace exit-gas temperatures*

All furnace walls of this Series "SC" Steam Generator are water-cooled by closely-spaced 3" OD tubes. As a result, setting maintenance is minimized and excessive furnace exit-gas temperatures prevented. The tubes are backed by first-quality refractory, heavy-duty insulation and fully-stayed steel casing.

This is another advanced-design feature of the Foster Wheeler Series "SC" Steam Generator that has been developed primarily for reducing power and process steam costs in industrial plants.

Series "SC" employs a standardized design. Dimensions and structural details are fixed. Yet the design provides a wide choice of working temperatures and pressures, balanced draft or pressurized firing, type and location of heat recovery equipment, type and location of fans and drives, oil or gas firing. This means that the "SC" boiler and its auxiliary equipment can be properly integrated to meet your individual plant needs.

FW Series "SC" Steam Generators are available for oil or gas firing, in capacities from 50,000 to 150,000 lb./hr., for pressures to 1500 psi and superheated steam temperatures to 950°F.

For further information, write *Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.*

OTHER FEATURES AT A GLANCE

- Over 19-foot firing depth
- Unrestricted circulation
- All-welded casing
- Fully drainable superheater
- Efficient convection surface
- Bottom supported unit
- Steam purifying system
- Full insulation

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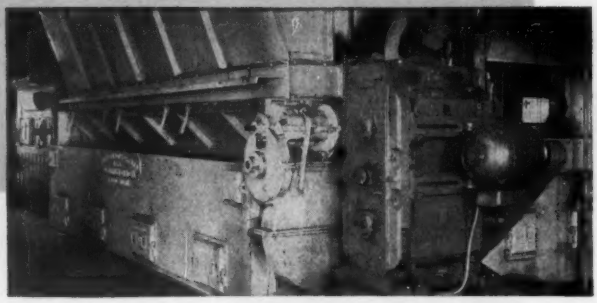

LACLEDE CHAIN GRATE STOKER AT IOWA STATE COLLEGE

The erosion of boiler pressure parts by fly ash of bituminous coal shortens boiler life. Also, reinjection increases the amount of erosion.

Laclede Chain Grate Stokers installations have no such problem.

Laclede Chain Grate Stokers

1. Burn coal with a minimum amount of fly ash.
2. Require no reinjection to efficiently burn bituminous coal.

Along with other progressive producers of steam who recognize these straightforward facts, the Iowa State College at Ames, Iowa has installed a Laclede Chain Grate Stoker of 350 square feet grate area to burn low grade Iowa bituminous coal to produce 120,000 pounds of steam per hour.

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MARMADUKE

Continued from page 202

and all I did was use my noggin instead of my muscles." That gave Marmy the floor. Soon as our ear drums stopped ringing, we were happy to listen.

"Back in 1910, I quit my job at St. Louis, as assistant chief of the stern-wheel river-packet *Nancy Lee*," bellowed Marmy, giving his old gray bowler a starboard list. Then he hooked his barnacle-covered fists into the armpits of his checkered vest and blasted away. "I shoved off from St. Louis and navigated for a rest on my uncle's farm near Mildew, Missouri. But after a few days of feeding hogs, milking cows and plowing with a stubborn pair of mules, I craved a little excitement. So I charted a course for the bright lights of Kansas City.

"After getting my bearings, I landed a job as master mechanic at the Kaw River plant of the Kansas City Ice Co. They had two plants. The large one was down in the river bottoms and the smaller one a few miles away on the south side.

"Both plants had large horizontal reciprocating ammonia compressors, directly connected to corliss engines. Condensers were the vertical open-shell type. Those had a larger condensing surface than the closed type and were easier to keep from getting fouled. Open condensers were used because the cooling water was dirty, being pumped directly from the river.

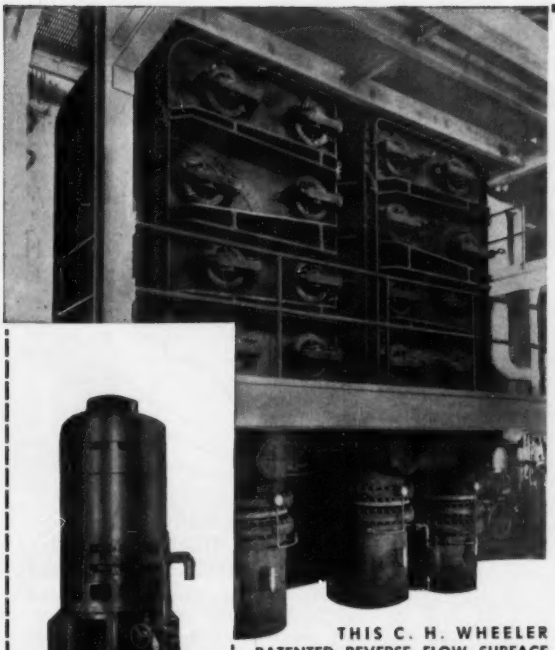
"The large ice storehouse of each plant was filled in winter when demand for ice was low. About 1000 freezing tanks yielded an ice harvest of 100 tons a day at the main plant.

"After steam-boating all winter, working at a shoreside job was OK for a change. Besides, it gave me a chance to catch up on my social activities with the fair sex. The ice business was booming in those days and the ice man was a mighty important guy in every neighborhood. And back at the plant it was our job to keep the wheels turning so he could make his deliveries on time.

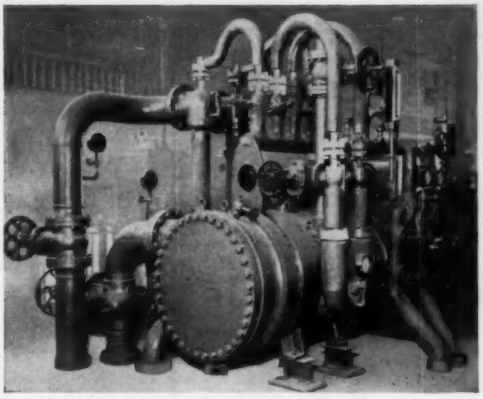
"My work kept me on my toes. One week, I'd be rolling in boiler tubes, keying up on an engine bearing, making piston rings, renewing old piping and maybe grinding in a few valves. Next week, an emergency repair job might keep me working around the clock.

"Biggest headache for all of us was the boss's son. The boss himself was a swell Swede by the name of Gunar Bjorklund. The old boy had pulled himself up by his bootstraps and made a lot of money in the ice business. He drove a team of smart-looking jet-black

"SELF-CLEANING" C. H. WHEELER PATENTED REVERSE FLOW STEAM CONDENSERS OPERATE ROUND-THE-CLOCK



THIS C. H. WHEELER PATENTED REVERSE FLOW SURFACE CONDENSER is a two pass, divided water box, dual bank design capable of condensing 440,000 lbs. per hour of exhaust steam. Condensing surface is 55,000 square feet.



C. H. WHEELER TUBEJET AIR PUMP consists of two 2-stage elements, mounted on surface type inter-after-condenser. Each 2-stage element is designed to handle 97.5 lbs. per hour air vapor mixture at 1 inch HG absolute.

C. H. WHEELER CIRCULATING PUMPS are 30" x 42" Vertical Mixed Flow, pull-out type. Capacity is 30,000 GPM each at a total head of 36.2 feet. Pumps are driven by 400 HP, 600 RPM synchronous speed vertical induction type motors.

New Deaerating Features Reduce Oxygen Content to Less Than 0.01 cc Per Liter

Progressive power companies are eliminating condenser shut downs and operation at reduced loads by installing C. H. Wheeler Patented Reverse Flow Steam Condensers.

One rapidly expanding utility has just put their fourth C. H. Wheeler Reverse Flow Condenser on the line. The latest unit, shown above, is not only "Self-Cleaning" but also has special new deaerating features that reduce the oxygen content of the condensate to less than 0.01 cc per liter. Continuous measurement by accurate recording instruments has proved that this low oxygen content is consistent over a wide range of load and temperature conditions.

Condenser circulating water used by this power company comes from a brackish river, laden with debris and leaves which clog steam condensers of regular design. "Self-Cleaning" C. H. Wheeler Patented Reverse Flow Condensers have solved their problem of how to avoid the expensive shut downs required to hand clean clogged tubes and tube sheets.

Debris is flushed away from the tubes and tube sheets simply by reversing the flow of cooling water through the condenser by means of hydraulically controlled built-in valves. Cleaning takes only a matter of minutes and can be accomplished under full load operating conditions with only a slight vacuum reduction. The power plant therefore can operate at full capacity round-the-clock.

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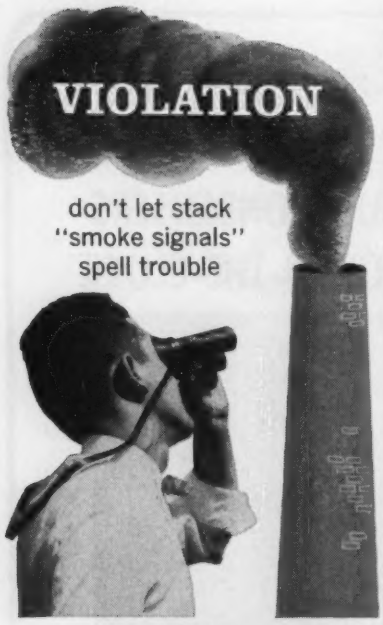

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P

MARMADUKE

Continued from page 204

horses and was active in civic affairs.

"But his son was a wise guy. He was a trouble maker and tried to gouge the old man for his cash without working for it. Being an only son, Junior was spoiled and got by with murder. Someone had to teach him a lesson, but we didn't think it would be the old man. He had great hopes for his youngster and overlooked his faults.

"His father had given him various jobs around his plants and even tried him out as manager of his main plant for a short while. But Junior was a smart aleck and no one would work for him. Besides, he would stay out all night burning up the town. Then he wouldn't show up for a few days at a time.

"The old man finally clamped down on the kid and made him night operator of his smaller plant on the south side. That was a big comedown from manager of the main plant, but the old boy figured he'd have to be on the job all night and maybe that would tame him down. Then, Junior would have to sleep during the day because the night spots where he wasted his time would be shut down when he came off watch.

"His father warned Junior that was his last chance. If he failed, he'd throw him out. But no one believed him. At least Junior didn't because he slept on the job all night and let Smokey, his fireman, run the works. The kid's negligence caused two breakdowns that made me put in extra hours, but I didn't squawk to the old man.

"The south-side plant wasn't doing much business just then. One of her two corliss engines was torn down for general overhaul. But our main plant was going full blast. One evening at quitting time one of our engines conked out. Checking her, I found her govenor, a dashpot and its assembly damaged in a freak accident. It looked like I could fix the governor, but we'd need a new dashpot and plunger to get that engine going. My helper and I had to get her rolling by morning, but I wasn't sure just how. The boss was in Chicago on business and it was up to me to do something.

"The two of us worked on that engine until about midnight, patching up the governor. There was no use getting Junior because he probably wouldn't know about spares for the dashpot—he didn't take that much interest in the business.

"Then I had a brainstorm. I remembered that one of the engines in the south-side plant was identical with the one we were working on. Maybe I

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Powerful hammer-like blows delivered by CLEVELAND Type "F" air vibrators prevent arching-over and plugging in bins, hoppers and chutes. These dependable units have been designed for use on all types of hoppers and bins handling sand, cement, cinders and all other granular materials.

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LSRR air vibrators utilize cast steel male wedge type mounting bracket which fits the female bracket that is standard equipment on most covered hopper railroad cars. In addition, female brackets can be furnished for attachment to bins, concrete forms, chutes, etc., and a single LSRR vibrator can be moved from one installation to another to handle several different applications.

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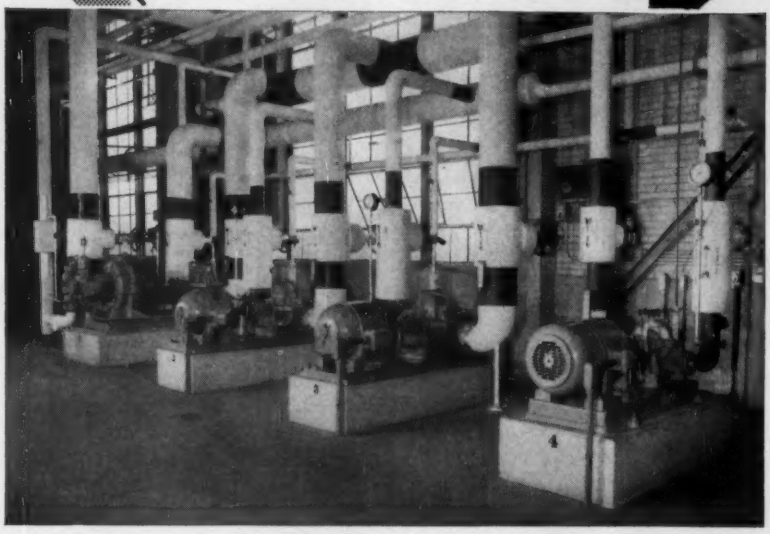

Photograph, courtesy Wyman Gordon Company. Other Warren Pumps in this plant include Condensate and Fuel Oil Transfer.

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WARREN QUIMBY PUMPS

P-33

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.

Warren, Massachusetts

MARMADUKE

Continued from page 206

could solve my problem and do the old man a good turn at the same time.

"My helper and I hitched up one of the delivery horses and started for the other plant with a bag of tools. We got into the engine room quietly, but found the engine shut down. Evidently Smokey the fireman had trouble keeping up steam because he was hauling his fire. And the boiler room was filled with smoke. I figured Smokey stopped the engine to keep from losing steam so he could start up again.

"Junior was asleep in the office, as I expected. This was our chance and it was made to order. We quickly removed the dashpot and plunger from the corliss and walked out as quietly as we entered. Leaving, we could hear Smokey working his fuel bed as his slice bar clanked away.

"Back at the main plant we had the new dashpot and plunger in place, and our engine was rolling by 5 am. Then the two of us washed up and went over to Mike O'Shane's Railroad Bar for a few snorts of Sandpaper Gin to keep us awake. Later, we scooted across the street to the Greek's for some breakfast. By 7 am we were back on the job as the day gang showed up. Only the shift engineer going off watch knew about our borrowed dashpot and we could trust him.

"But all hell broke loose about then at the south-side plant, as we learned later. When Smokey finally got his fire straightened out, he tried to start the engine he had stopped a short time before. But it wasn't all there. After scratching his head for a while and trying to figure things out, he walked into the office where Junior was snoring with his feet up on the desk. Smokey stood there with his fists doubled and glared at Junior.

"Finally he blew his stack, 'Git up, you dirty double-crossing thief,' yelled Smokey, hauling off and smacking Junior into a heap. The kid started picking himself off the floor and looked around to see where the cyclone came from. Then Smokey busted Junior in the nose with a haymaker and knocked him into the middle of the next week.

"'Here I am, sweating myself into a corpse to keep your rotten plant running while you sleep. And what do you do? Go around playing kid tricks by taking the engine apart. And you got the guts to act like you're sleeping and don't know nothing about it.' Man, he was really burned up.

"Junior didn't know exactly what had happened when he came to. Smokey had dressed and was gone. But that beating

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ZIMMERMAN PACKING

CINCINNATI 12, OHIO

MARMADUKE

Continued from page 208

is exactly what the kid had needed for a long time.

"When the kid finally got round to starting the engine he also found part of it missing. He thought Smokey had pulled a fast one. And not knowing about our breakdown at the main plant, he didn't tie the missing dashpot up with us. Junior was really confused.

"The old man returned from Chicago by sleeper that morning and was down at the office at 8 am as usual. Then the day engineer called from the south-side plant and told him he couldn't start the engine because part of it was missing. That's when the old boy blew a gasket. He drove over there in a hurry and found Junior with two black eyes and his face all beat up. But he didn't say anything until he saw his corliss. Then he got pink around the gills and popped his safeties. The kid was canned on the spot. Only this time he told him to get out of his house as well as his plant. And that was that.

"Things settled down after Junior left, but the old man wasn't happy. Business was good, but Junior had pulled the rug out from under his father by letting him down. For the first time in the old man's life he didn't have a good reason for carrying on.

"During this time there were all kinds of wild theories about the missing dashpot, but none was wilder than the boss's. He couldn't dope out why his kid should wreck one of his engines. That really hurt.

"I learned that Junior had a job at the freight station and was living at a cheap boarding house since the old man gave him the boot. One evening I looked him up. It seemed to me the kid was coming to his senses since he couldn't lean on his father.

"That winter I got the wanderlust for the sea again. I planned to ship down river to New Orleans and sign aboard a deep-sea ship for the west coast of Africa. Before being paid off. I told the old man I had the straight dope on that missing dashpot, but he'd have to have dinner with me to find out. The old boy gulped a few times, then stared at me for a few seconds. Finally he agreed. But I could see he was suspicious. Then he insisted that I be his guest and that I meet him at the swanky Vendome Hotel.

"Next evening when the boss and I sat down to dinner, Junior walked in, just as I planned. Both men were surprised and looked at me to explain. I gave them the lowdown on that missing dashpot. The old man lighted up like a Christmas tree. He felt good to know his kid was innocent. Then he

ILLCO-WAY

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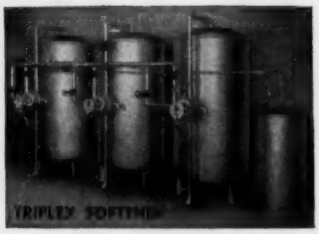

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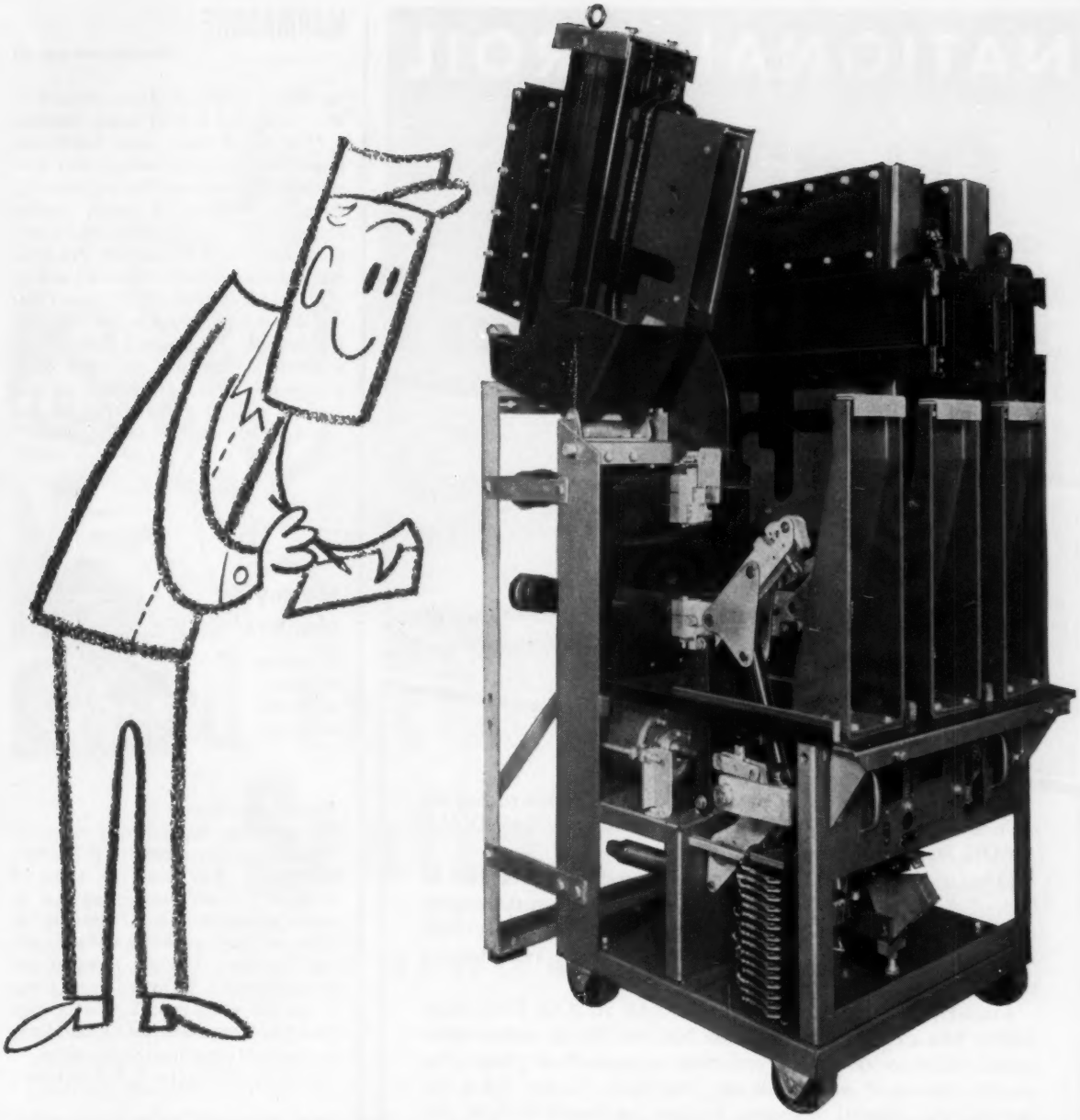

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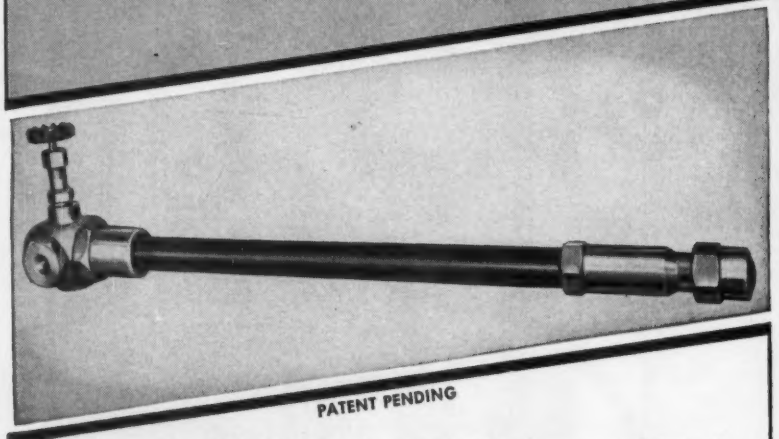

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INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

MARMADUKE

Continued from page 210

busted out laughing. Junior chimed in and we all had a good laugh together.

"The payoff came when Junior surprised his father by telling him he'd learned his lesson and that he'd knuckle down to business if given another chance. That was like pouring oil into a dry bearing. The old man was hearing something he never expected to hear —it could only come from a person who had sobered up enough to get his thinking straight. So mixing a little human engineering with that 'borrowed' dashpot not only solved my problem—it also made a man of a young jackass and cured the old man's headache to boot."

—*SME*

Marmy's Mailbox

'Tis here you exchange blasts with the old boy

WORLD-FAMOUS BEER

We are happy to see one of our cases of San Miguel Beer featured in Marmy's latest story. You might be interested to know that our engineering and research departments find POWER so valuable we have carried several subscriptions for years. You will, therefore, understand what a distinct pleasure it was to see our world-famous product mentioned by that world-famous consulting engineer, Marmaduke Surfaceblow.

Manila, Philippines J B PREYSLER

LIKES THE OLD BOY

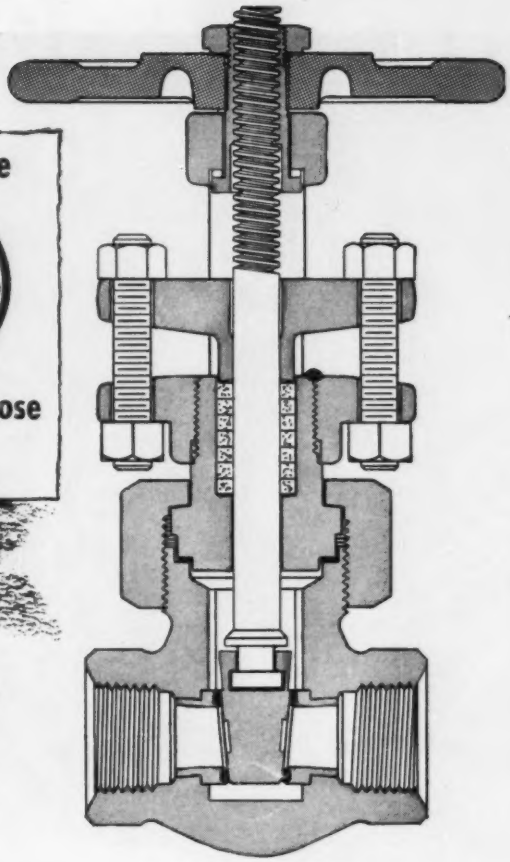
My new book *The Marmaduke Story* is interesting. I have been reading the old marine engineer's yarns in POWER for some time. We in the shipping business like to keep up with the old boy's experiences.

New York, N. Y. H R GLENNON

COFFEE BINGE

If Marmy keeps up this coffee binge instead of drinking Sandpaper Gin, I won't be surprised one of these months to see him sitting at a table in some sissy tea room where old maids hang out. When is the old boy going back to his hard likker, like all good marine engineers? He needs it to keep him going.

Englewood, N. J. G THORNTON



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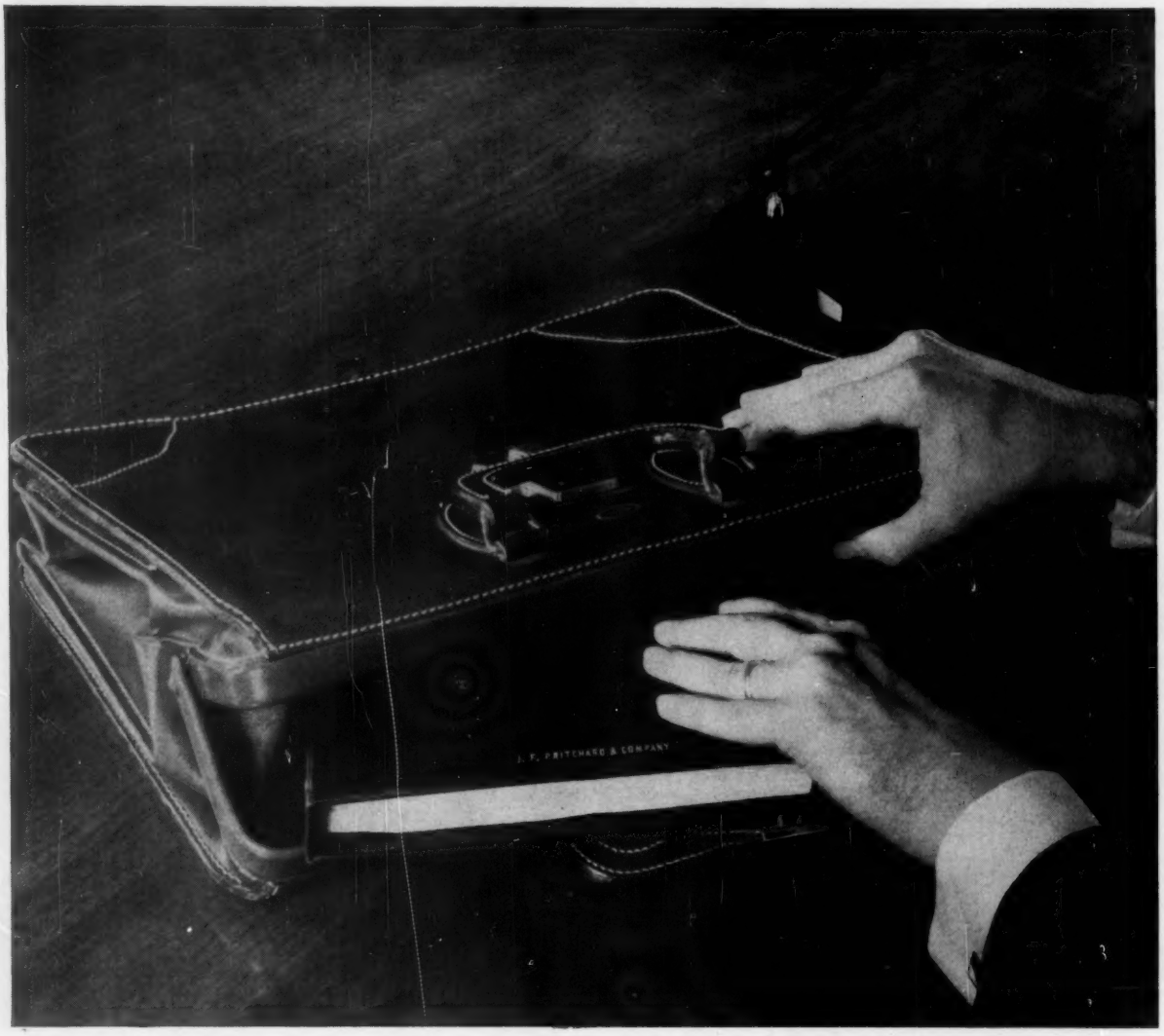
DROP FORGED STEEL

VALVES



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"I know you've been working with them on plans for the new power plant, but why are you so pleased?"

"Because this is a Pritchard Single Responsibility Contract."

"What kind of a contract is that?"

"It means that Pritchard has taken full responsibility for everything—engineering, design, drafting, purchasing and construction."

"Oh, I see! This way you are dealing with just one company and not a lot of different ones. Is that it?"

"Yes, but just part of it. With this contract, we know what the total cost of the plant is going to be before it's started. Pritchard co-ordinates all of the buying. They save us money on labor. And we get a firm guarantee of operation of the completed power plant. One more very important thing—perhaps the most important . . ."

"What's that?"

"We start getting a return on our investment faster because the construction job gets done faster."

"I can see now why you feel so good about that contract."

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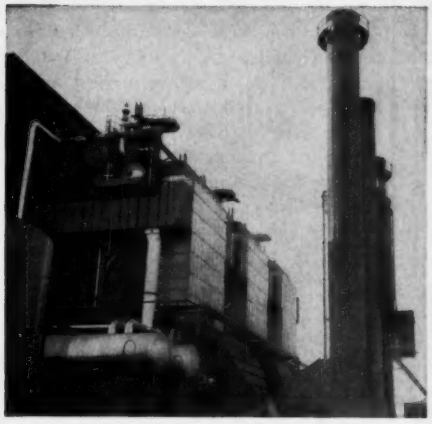

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Two, Pritchard ability to work *with* your staff on every step from drawing board to completion!

Three, Pritchard's time-saving, money-saving, Single Responsibility Contract!

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STEAM TRAPS

Continued from page 113

to bring the trap back to top performance. Each trap should be given an operating test in the test stand, as explained above. After the test, tag the trap for its pressure rating, overhaul date and suitability for use. Place trap in stock with other overhauled units.

Radiator traps, usually the bellows thermostatic type, should be checked during the summer. Keep a stock of replacement bellows on hand. Check old bellows on the test stand.

Accessories. While checking trap efficiency, it is good practice to look over the installation to see if any of the following accessories are needed.

Dirt leg, at *A*, Fig. 5, is easily installed using a tee and capped nipple. It will catch most of the sediment forming in the steam line and the equipment cavities. Clean the leg when trap is serviced.

Air vent on the equipment trapped often gives better operation, steps up output. In Fig. 5 the area lost to heat transfer when a vent is not used equals the product of *D* and the inside circumference of the kettle. Using the air vent greatly reduces the cooking time.

Vacuum breakers are used where temperature-control or motorized control valves are employed. In Fig. 5 the control valve closes after the process is up to temperature. Steam in the jacket condenses, creating a vacuum. Without a vacuum breaker the condensate does not drain out of the jacket for a prolonged period. Some traps may lose their prime without a breaker.

Check valves are important, preventing the discharge from one trap backing up into that of another. When condensate from a trap must be lifted, a check valve should also be used, as in Fig. 3. While manufacturers recommend individual trapping of equipment for most units, check valves should be selected where individual trapping is not possible or group trapping must be used. Install a check valve in the discharge line from each section of the steam-condensing equipment, ahead of the trap.

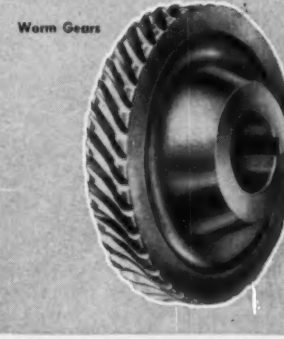
Fig. 6 shows the standard bypass arrangement. While the original idea of the bypass is good, too often an operator bypasses the trap, thinking he can increase production. If the safety factor for the trap is too low to allow the trap to handle the start-up load, the bypass can help. But if it is left open, it wastes steam. And if left fully or partly open, it either backs up condensate or wastes steam because a fixed orifice cannot handle variations in steam pressure and condensate load. Opening the bypass wide makes it impossible to maintain

built for LONG, TOUGH service

PHILLIE GEAR

Continuous tooth Herringbone Gears

Spiral Bevel Gears



Worm Gears

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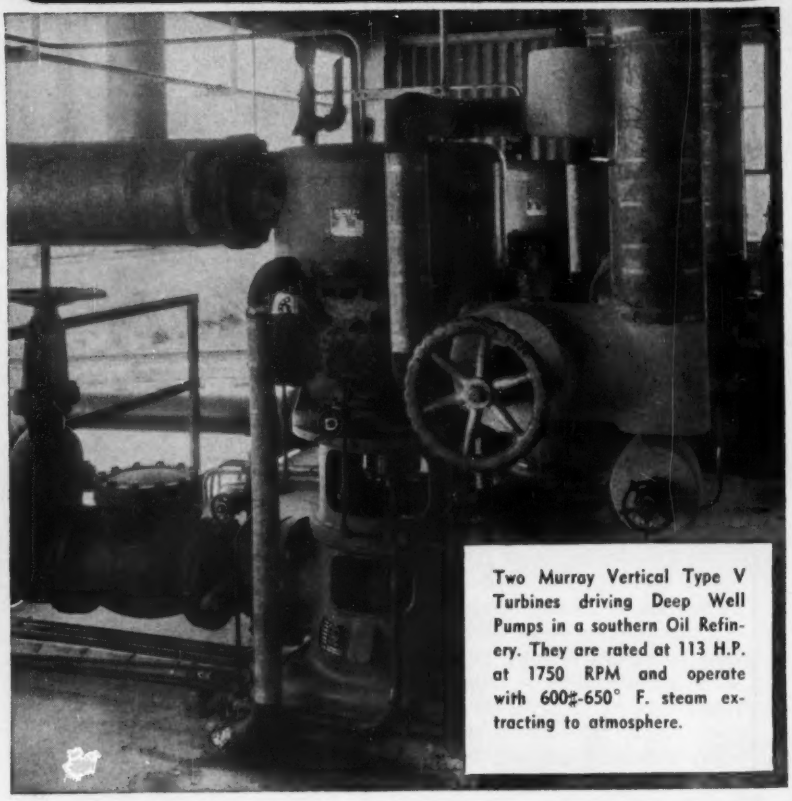
Established 1892

Murray Turbines



Two Murray Vertical Type V Turbines driving Deep Well Pumps in a southern Oil Refinery. They are rated at 113 H.P. at 1750 RPM and operate with 600#-650° F. steam extracting to atmosphere.

● Murray Vertical V turbines, both geared and direct-connected, are being used more and more for driving vertical pumps of all types. The Murray Vertical V turbine is designed from top to bottom as a vertical turbine, not just a horizontal turbine, "upended". The Murray Vertical is especially constructed and arranged for vertical mounting.

Murray vertical turbines can be furnished for steam pressures up to 600#, 750° F. TT. and back pressures as high as 100# and can carry most normal thrust loads imposed by vertical pumps.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

STEAM TRAPS

Continued from page 215

maximum pressure in the equipment, reducing production capacity.

Today many major steam plants do not use a bypass. On outside installations the trap can be bypassed by using the strainer blowoff. This acts as a signal, too, indicating the trap is out of service. If a trap cannot be spared while being serviced, it is advisable to use the double-trap bypass, Fig. 6. The additional trap often pays for itself in a few days, compared to standard bypassing.

Waste heat can be recovered from flash steam by a heat exchanger. The heat can be used to raise the temperature of boiler-feed water, hot-water heater feed, or any other preheat service. Recovering this heat improves plant efficiency.

Routine maintenance of traps can save money. Why not set up your program today?

My biggest boner . . .

I was water tender in a boiler room, having 10 oil-fired and 10 underfeed stoker-fired boilers. Boiler-room engineer left orders that night to cut out a coal-fired boiler for repairs next day. My engineer passed word to me. I, in turn, told operator in charge of battery.

While he was burning out his fire, I made out tags. When boiler pressure dropped, I cut her out and closed all necessary valves. Then I notified ash gang about boiler coming down. They let me know as soon as they emptied the ash hoppers so I could tag them.

But down in the ash cellar I pulled a boner and put tags on a live boiler instead. Day gang came on next morning and started to remove ashes from hoppers. They started to open the ash gate slowly. As luck would have it, a boiler repair man working on the boiler felt the gate opening and grasped something to prevent him falling into the ash can below. That saved him from serious burns and broken limbs.

Next day when I came on, the assistant boiler-room engineer was laying for me. He asked who had tagged the boiler. I told him I had. When he told me what I had done, I felt pretty low. My carelessness could have been tragic. Since then, I always double check everything that might cause an accident.

F A Turano *Jersey City, N. J.*

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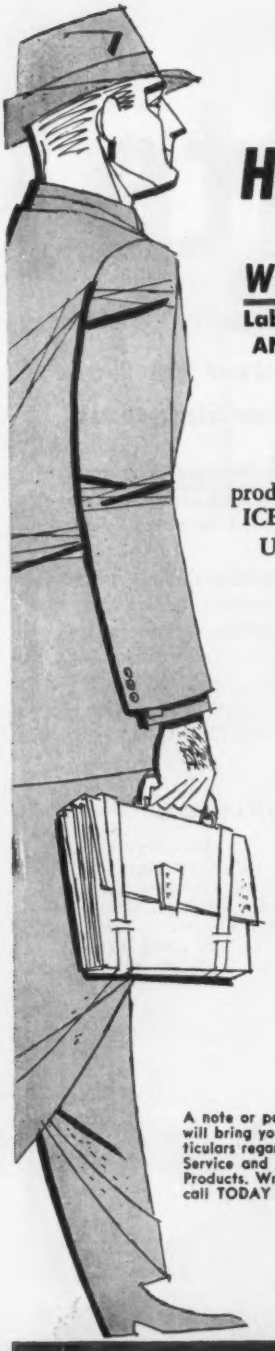

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BOOKSHELF

Design of Heating and Ventilating Systems. *By F W Hutchinson, Prof of Mech Engrg, Univ of Calif. 320 pp, 98 illust, cloth, 6x9, $7.00. The Industrial Press, 93 Worth St., New York 13, N. Y.*

Emphasizing engineering science as applied to system design, the treatment in this volume is selective. It places emphasis on problems that require rational application of engineering knowledge rather than on those elements that are either selected or designed on an empirical basis.

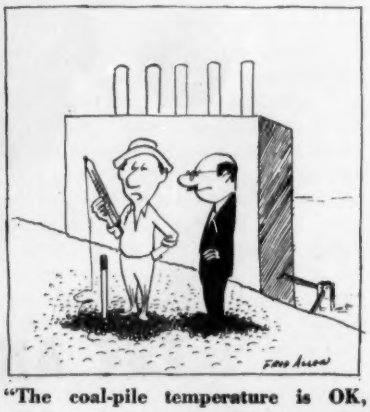
Considerable space is given to panel heating, solar heating and airway design. A total of 96 working charts, accompanied by explanatory text and examples, make the book valuable to designers. In many cases the charts completely eliminate need for calculation, while in others the work is minimized.

Much data are given on systems using partial solar heating. Research by the author provided much of the engineering information for this section. It is believed that this is the first text on heating to include engineering data on this subject.

Hydraulic Pumping. *By Emory N Kemler, Prof of Mech Engrg, Univ of Minnesota. 7x9, cloth, illust, $15.00. Summary Reports, P.O. Box 176, Spring Park, Minn.*

The ever present demand for lower pumping costs and the more severe requirements of deep wells, place a continuing demand for new or improved pumping equipment. One approach to this problem which has been used and is receiving increasing attention is hydraulic pumping.

This book summarizes a considerable portion of the patent literature relating to hydraulic pumping. The presentation does not attempt to evaluate either hydraulic pumping or the patent literature. It does, however, make the normally inaccessible storehouse of ideas, included in the patent literature, available to those interested in the general subject of hydraulic pumping. Pump designers can probably secure many good ideas from this book.



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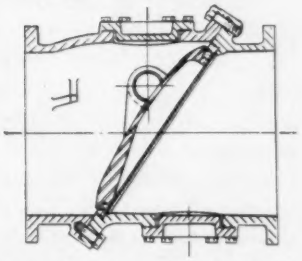

This specially designed "airfoil" disc balances perfectly in open position. The fluid holds the disc tightly against its stops without flutter. The body of the valve is larger around the disc, so the net valve area is at least as much as the pipe area to assure low flow resistance.

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Request full information on "John Crane" FreeFlow gaskets for your particular requirement. Ask for our informative booklet, *The Best in Teflon*, for other important technical and application data. Crane Packing Company, 6430 Oakton St., Morton Grove, Ill. (Chicago Suburb).

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*DuPont trademark

JOHN CRANE CRANE PACKING COMPANY 38 YEARS INDUSTRIAL PROGRESS

More FREE LITERATURE

Begins on page 169

9 **Aerator unit.** Illustrated 4-p bulletin describes *Bin-Flo* aerator—a device that provides uniform and continuous flow of dry, finely ground materials from bins, hoppers and chutes. The Bin-Dicator Co, PO Box 3708, Detroit 15, Mich.

10 **Lightweight puller.** Portable device for miscellaneous lifting and pulling jobs throughout industry is described in 6-p bulletin 146-G. Unit is available in capacities from ¾ to 6 tons. Chisholm-Moore Hoist Division, Columbus McKinnon Chain Corp, Tonawanda, N. Y.

11 **Segregating valves,** slide-gate type, for pneumatic materials-handling systems are detailed in illustrated 4-p data sheet Ua. Includes application, design, operation data, drawings and tables. The Allen-Sherman-Hoff Co, 259 E Lancaster Ave, Wynnewood, Pa.

MECHANICAL TRANSMISSION

12 **Fluid drive,** *Type V8 Class 2F* adjustable speed, for diesel-engine applications. Bulletin 9619 describes construction, operational features. Includes photos, schematic drawings, specs, tables, 8-pp. American Blower Corp, Detroit 32, Mich.

13 **Multi-V belts.** Illustrated 4-p bulletin covers Grommet V-belts, high-capacity Grommet V-belts, high-capacity static conducting belts, oil-resisting V-belts and double V-belts. B F Goodrich Co, Industrial Products Div, Akron, Ohio.

PIPING, VALVES, FITTINGS

14 **Piping.** How processing and power piping costs can be reduced in materials, design and construction is the subject of illustrated 12-p bulletin. Details company's "general analytical method of piping flexibility analysis." The M W Kellogg Co, Fabricated Products Div, 225 Broadway, New York, N. Y.

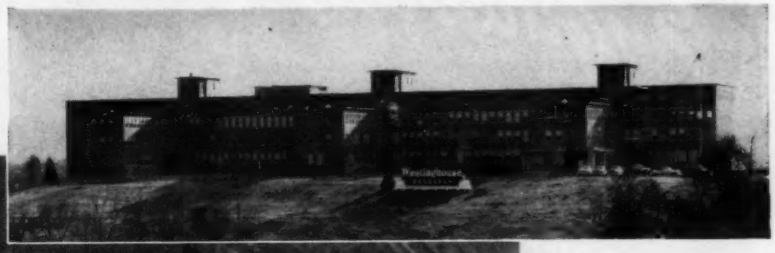
15 **Piping diagram** and steam trap selector for chemical processing equipment is contained in 12-p bulletin T-9. Features 3-p fold-out piping diagram for 22 pieces of typical processing equipment—each showing recommended steam trap and piping arrangements. Yarnall-Waring Co, Chestnut Hill, Philadelphia 18, Pa.

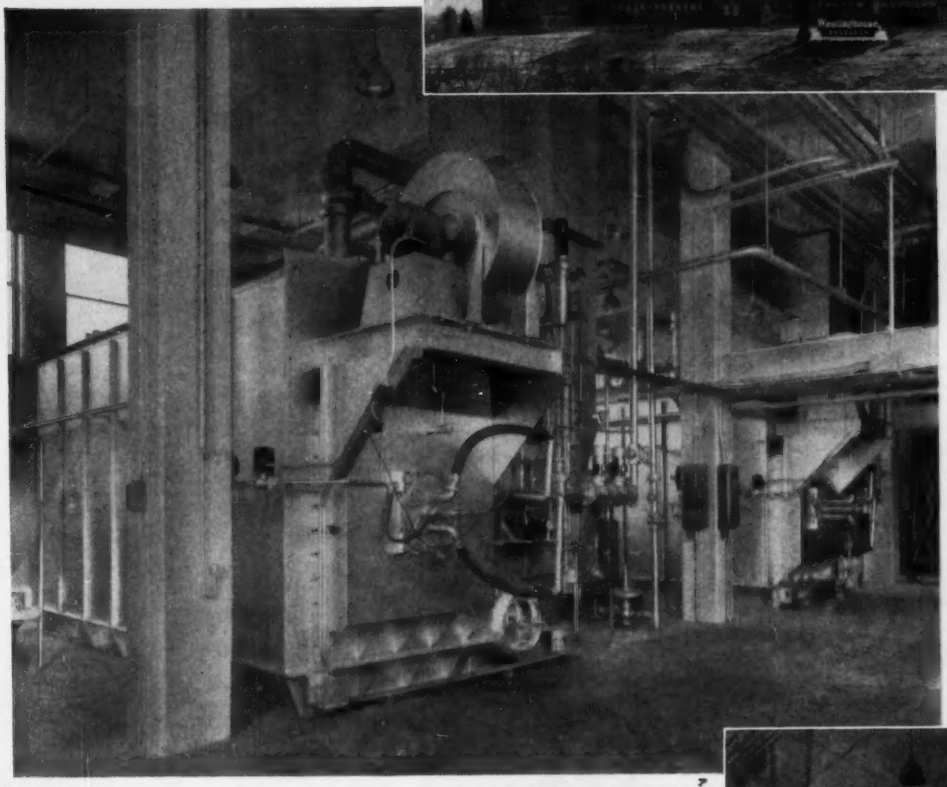
16 **Pressure pipe** and tubing, seamless or welded, intended for sub-zero temperature applications, is subject of 6-p bulletin TB-357. Contains application data, property and characteristics chart. The Babcock & Wilcox Co, Tubular Products Div, Beaver Falls, Pa.

17 **Solenoid valves.** Illustrated 4-p bulletin K describes stainless steel units—normally closed and nor-

TWO NEW KEELER TYPE D-K PACKAGE BOILERS SERVE NEW WESTINGHOUSE RESEARCH LAB

Westinghouse Research Laboratory
Churchill Boro, Pittsburgh, Pa.





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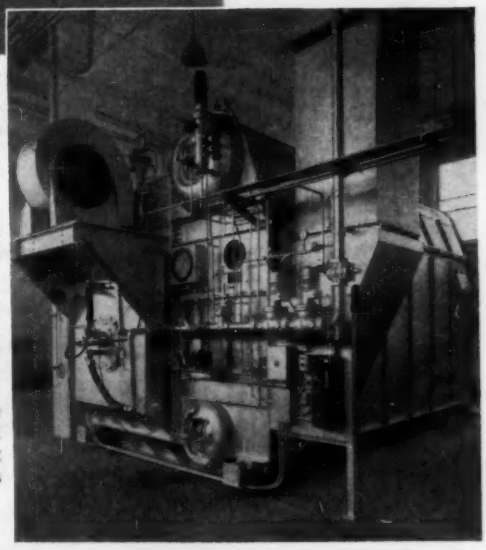

Westinghouse Electric Corporation has selected two Keeler D-K Package Steam Generators to supply their modern new research laboratory with low cost steam for process and heat requirements. Keeler Boilers of various types and sizes are serving Westinghouse plants throughout the country and their efficiency, economy and dependability led to the purchase of the two D-K units pictured here.

Each of the new Keeler Type D-K Boilers shown are capable of generating 20,000 lbs. of steam per hour. The complete "package" includes all burning equipment, controls, safety devices and accessories for gas fired operation.

The Type D-K is made in oil or gas fired units with capacities from 8,000 to 45,000 lbs. of steam per hour, standard design pressure of 200 psi and a maximum design pressure of 325 psi. The D-K is specifically designed for use in power plants which will not accommodate long boilers of other types.

It incorporates the proven efficiency and economy of Keeler Water Tube Steam Generators in a new, compact design—a comparatively wide and short boiler that's completely steel encased and insulated, ready for quick hook-up and operation. Write or phone for complete information on this compact, new Package Power Plant!

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Begins on page 169

mally open types in 1¼, 1½, and 2-in. sizes—designed to eliminate hammer and shock in automatic or remote-control of chemicals, steam, air, gas and other liquids. J D Gould Co, 730 E Washington St, Indianapolis 2, Ind.

18 **Bronze** or *Milvaloy* valves for the oil industry. Illustrated 12-p bulletin B355 lists over 150 valves, provides specs and data on all valves listed, charts sizes and applications of each valve. Milwaukee Valve Co, 2375 S Burrell St, Milwaukee 7, Wis.

19 **Valve chart.** Condensed comparson chart shows manufacturer's valves that are equivalent in structure and specs to those of eight other companies. The Ohio Injector Co, Wadsworth, Ohio.

20 **Welding fittings** and flanges are described in 6-p bulletin FB-500. Contains data on alloy, carbon and stainless steel units, selection charts. The Babcock & Wilcox Co, Tubular Products Div, Beaver Falls, Pa.

PUMPS

21 **Process pumps.** Illustrated 20-p bulletin 7094-B describes vertically split, single-stage and two-stage type units. Contains design features, dimension tables, cross-sectional and installation views, chart showing extensive interchangeability of parts through the entire line of pumps. Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y.

22 **Displacement** and centrifugal pumps, designed to meet demands of the chemical and allied process industries, are described in 4-p bulletin. Contains photos, specs, applications. Eco Engineering Co, 12 New York Ave, Newark 1, N. J.

23 **Sump pumps** can be supplied for sump depths from 2 to 11 ft in multiples of 1-ft for any pumping requirement. Illustrated bulletin 4500 provides a keyed selection of units based on capacity in gpm and total head in feet. The Deming Co, Salem, Ohio.

WATER TREATMENT

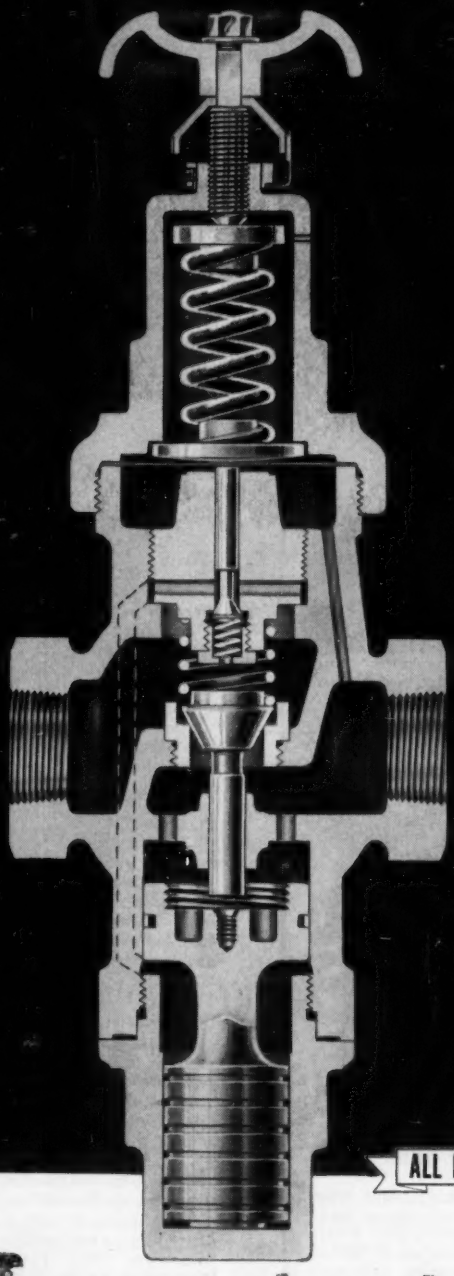
24 **"Treatment** for cooling tower systems: synergized polyphosphates plus low pH" is title of 2-p bulletin. Explains how process prevents scale, corrosion and wood rot. National Aluminate Corp, 6222 W 66th Pl, Chicago 38, Ill.

25 **Chlorine gas feeder,** equipped with automatic safety features, is subject of 4-p bulletin 840-L23B. Contains data on operation, methods of control, photos, and flow diagrams. Builders-Providence, Inc, 345 Harris Ave, Providence, R. I.

26 **Moisture measurement.** Illustrated 12-p bulletin 224 discusses gravometric, dew point and wet and dry bulb methods—as well as

MASONEILAN No. 11

FOR STEAM



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Less Maintenance Expense

Service records show maintenance usually consists of little more than keeping the moving parts clean. All parts may be removed and replaced with the valve in the line. A wider range of reduced pressure settings . . . and an unusually sturdy construction — make it the finest, most economical valve in its class.

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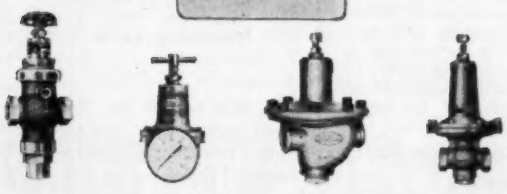

No. 11 for steam No. 71 for air No. 227 for water No. 33 for steam, air

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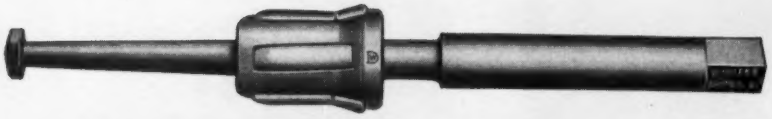

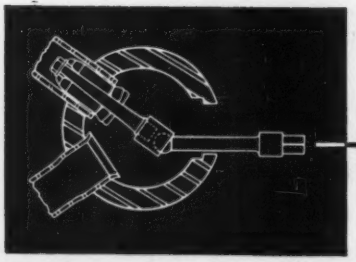

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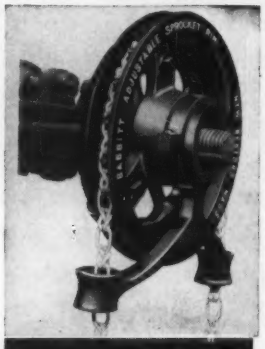

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More FREE LITERATURE

Begins on page 169

some less used and experimental schemes — for measuring water vapor in air and other gases. Pittsburgh Lectrodryer Corp, PO Box 1766, Pittsburgh 30, Pa.

WELDING

27 **CO_2 welding.** Article reprint deals with methods of supplying and flow characteristics of carbon dioxide, chemical activity of carbon dioxide, properties of weld metal, operating characteristics and specific applications. Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y.

28 **"Welding with bronze** electrodes-filler rod-wire" is title of bulletin W-17. Contains technical data on welding techniques, processes, procedures. Includes weldability chart, recommended welding currents. Ampco Metal, Inc, 1745 S 38th St, Milwaukee 46, Wis.

29 **Arc welder** that permits the selection of four types of arc is detailed in 8-p bulletin 1343. Contains full descriptions, typical applications, design features, photos. The Lincoln Electric Co, Cleveland 17, Ohio.

MISCELLANEOUS

30 **"Design of nickel** magnetostriction transducers" is title of 38-p bulletin that summarizes all practical experiments to guide the engineer toward a workable design in exploring new fields in the sonic and ultrasonic regions. The magnetostrictive transducer is used to convert electrical input energy to electrical output energy. The International Nickel Co, Inc, 67 Wall St, New York 5, N. Y.

31 **Silicone products.** 1956 reference guide describes almost 150 of the most generally used silicone products. Items are grouped by physical form and cross-indexed by usage. Dow Corning Corp, Midland, Mich.

32 **Industrial engines.** Illustrated 16-p bulletin 12009 describes company's turbo-diesel units, gives advantages of turbocharging, tells how a turbocharger works. Cummins Engine Co, Inc, Columbus, Ind.

33 **Tubing, pipe insulation** with *Flexi-Grip* zip-on feature is subject of 4-p bulletins 7 and 8. Contains drawings, applications. Miracle Adhesives Corp, 214 E 53rd St, New York 22, N. Y.

The first two of four Enterprise tri-fuel diesel engines have been accepted for New York City's enlarged Bowery Bay Pollution Control Project.

Lambda Electronics Corp has opened a new manufacturing plant at 11-11 131st St, College Point 56, N. Y.

New BETTER way to insulate plant piping

gb SNAP*ON

Less than two years ago it was a time-consuming and expensive job to insulate plant piping. Not so today, thanks to a new concept in pipe insulation — G-B Snap*On, the new one-piece molded pipe insulation of fine glass fibers.

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All this adds up to quicker, easier application than you've ever experienced. So don't fail to try Snap*On the very next time you need insulation from chilled or heated piping where temperatures do not exceed 350°. You'll find there's absolutely *nothing* like it for *economical application, thermal efficiency* and *permanence.*

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More TECHNICAL BRIEFS

Begins on page 156

summarize what has previously been published on this subject, to present certain new information, and, in some instances, to amplify the old. While he has tried to make the review complete, it is expected that some authors will have been unintentionally overlooked. Throughout, an emphasis has been placed upon engineering utility of the results. *ASME paper No. 55-SA-18.*

The dynamic response of industrial thermometers in wells. *Thomas C Linahan, Minneapolis-Honeywell Regulator Company, Brown Instrument Division.*

Previously published analyses of the dynamic response of thermometers in wells have neglected either the internal-distributed well resistance or the internal bulb resistance. This paper considers an "effective" resistance and capacitance of the bulb when it is in a well. The distributed resistance and capacitance of the well are included, and an approximate second-order expression for the dynamic response is developed using a combined analytical and experimental approach. There is also a brief discussion of the film coefficient of heat transfer. *ASME paper No. 55-SA-52.*

Boiler fouling

The sintering test—an index to ash-fouling tendency. *By D H Barnhart and P C Williams, The Babcock & Wilcox Co.*

This paper describes a laboratory test for determining the tendency of an ash to form hard, bonded deposits in the convection tube banks of coal-fired boilers. The test has been applied to several phases of the problem.

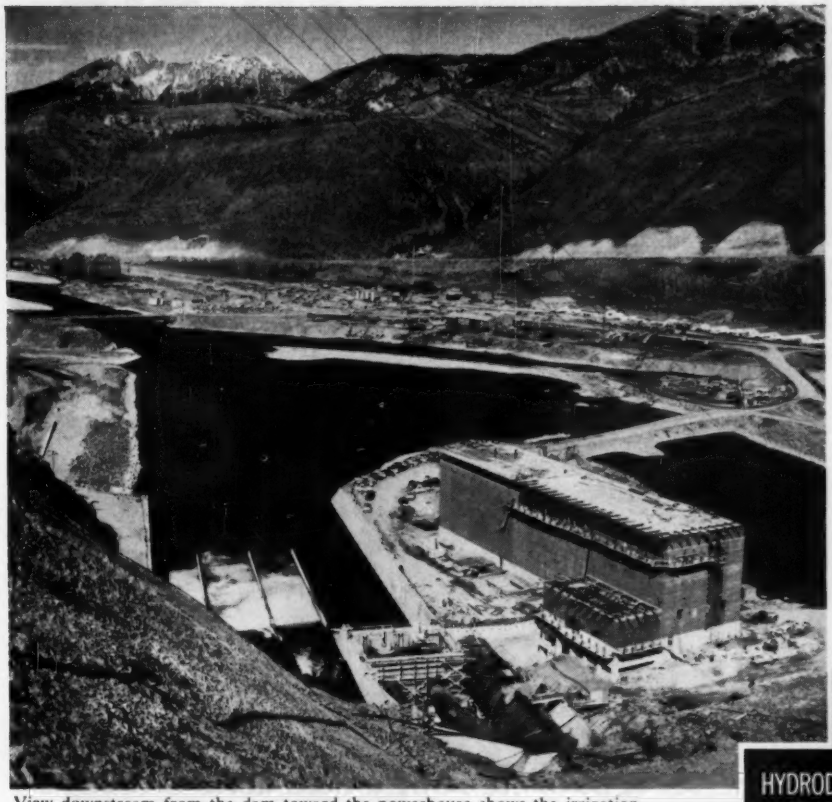
If a coal ash is troublesome, the test is useful for evaluating the effect of additives in changing ash characteristics. *ASME paper No. 55-A-193.*

High temperature corrosion of alloys exposed in the superheater of an oil-fired boiler. *By D W McDowell Jr and R J Raudebaugh, The International Nickel Co, Inc, and W E Somers, Public Service Electric & Gas Co.*

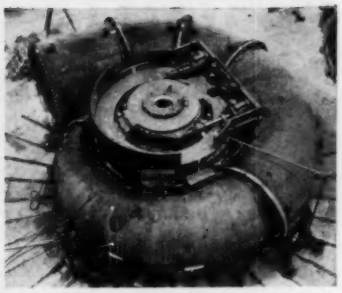
A series of heat-resistant alloy test racks containing 30 odd test specimens were installed in the gas inlet of the second bank of the superheater in a Public Service Electric and Gas Co boiler. This unit had been burning bunker C for three years before the test and used it during the entire test period.

Scale taken from the test specimens

Directions for ordering papers on p 230

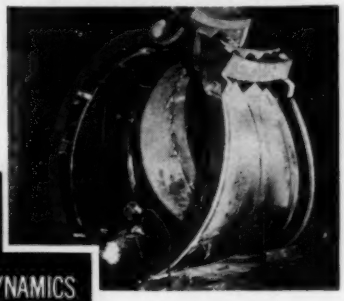


View downstream from the dam toward the powerhouse shows the irrigation bypass (left), penstock (center) and tail-race canal (right). *(U.S.B.R. photo)*



Final check assembly of Unit #2 – a complete scroll case, pit liner, distributor gates and operating mechanism – is made in SMS shops prior to shipment to the site.

Welding a flange to a section of Unit #3's spiral steel case. SMS shops are completely equipped to fabricate weldments of the largest types.



HYDRODYNAMICS

MILE-HIGH SMS-FRANCIS TURBINES SOON TO DELIVER POWER AT PALISADES

High on the south fork of Idaho's Snake River, the first of four SMS-Francis turbines at Palisades Dam is scheduled to go on the line in 1956. The Palisades Dam, which is the Bureau of Reclamation's largest earth-filled dam, is primarily an irrigation project. The dam will have a crest length of 2,100 feet, rise 270 feet above the streambed, and provide a storage reservoir some 20 miles long and 3 miles wide.

Four vertical SMS-Francis turbines will be installed to produce a total capacity of 114,000 kw. Designed to operate at a site more than a mile above sea level, each unit is rated at 39,500 HP under a 190-foot head. The power generated will serve southeastern Idaho, where Atomic Energy Commission facilities and a growing phosphate industry now tax the existing electric supply.

Whatever your needs in hydraulic turbines and accessories may be, S. Morgan Smith offers 79 years' background in designing and manufacturing equipment for world-wide installation. This experience – over 16,000,000 HP installed capacity – is your greatest assurance of satisfactory equipment performance. For full information, write S. Morgan Smith Company, York, Penna., U.S.A.

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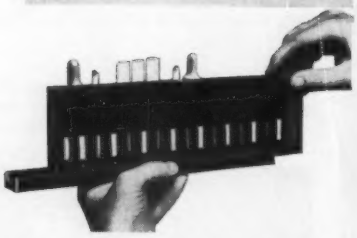

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More TECHNICAL BRIEFS

Begins on page 156

analyzed as high as 36% vanadium pentoxide and 32% sulphuric anhydride. Some alloys had a corrosion rate as much as 10 times greater than others. Test results should give much valuable data aiding in selection of materials for environments where bunker C oil is used. *ASME paper No. 55-A-203.*

Bonded fireside deposits in coal-fired boilers—a progress report on the manner of formation. *By C H Anderson and E K Diehl, The Babcock & Wilcox Co.*

This paper discusses composition and formation of ash deposits on convection surfaces of coal-fired steam boilers. Innermost layer of these deposits has different chemical and physical characteristics than bulk of the deposit. It is important in bonding the deposit to the tubes. *ASME paper No. 55-A-200.*

Flyash refiring. *By F G Feeley, Jr, Carbide and Carbon Chemicals Co.*

The 30-year growth of the facilities of the author's company has been accompanied by a flyash disposal problem. Three years ago, when the addition of a new 250,000 lb-per-hr boiler was contemplated, it was decided to incorporate refiring features which would largely eliminate the difficulty.

Performance and tests show excellent results. *ASME paper No. 55-A-182.*

The work of the central electricity authority (Britain) on the fouling and corrosion of boiler plant. *By H E Crossley, Central Electricity Authority, London, England. ASME paper No. 55-A-153.*

Ash deposits on boiler surfaces from burning central Illinois coal. *By J R Michel, Commonwealth Edison Co, and L S Wilcoxson, The Babcock & Wilcox Co. ASME paper No. 55-A-95.*

Electrical equipment

Thermal protection of motors. *By G R Horcher, The Dow Chemical Company.*

The problem of thermal overload protection of motors is to prevent the windings from exceeding their temperature limit, while at the same time permitting full utilization of the motor capacity. As the motor winding temperature increases beyond this limit, the deterioration of the insulation is accelerated. Temperature-aging tests on Class A insulation have shown that the life of the insulation is halved for each 10-C increase in continuous operating

Directions for ordering papers on p 230

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and 2 new Power Drives

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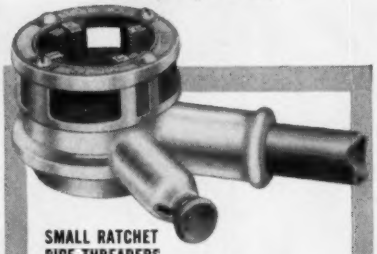

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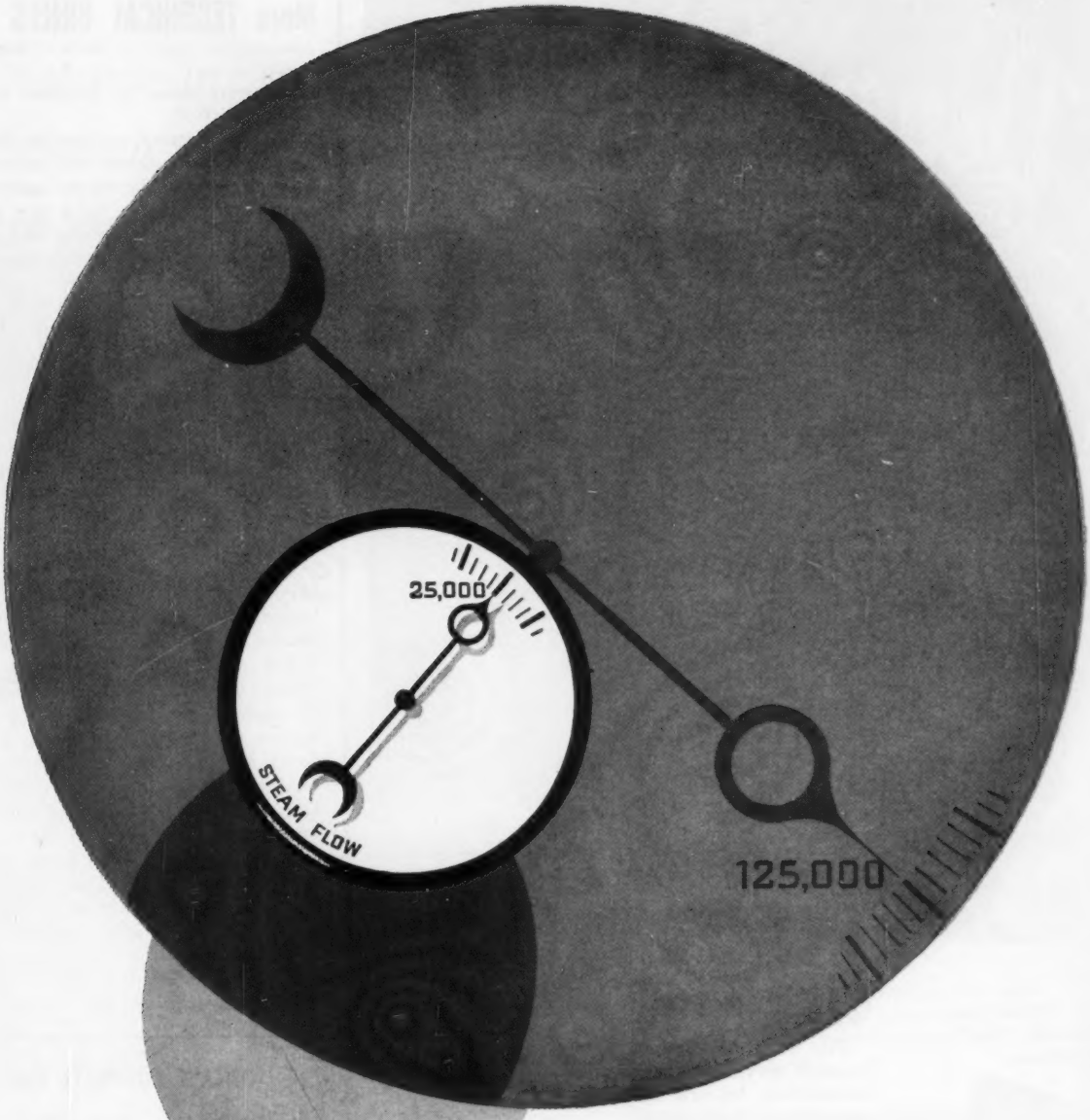

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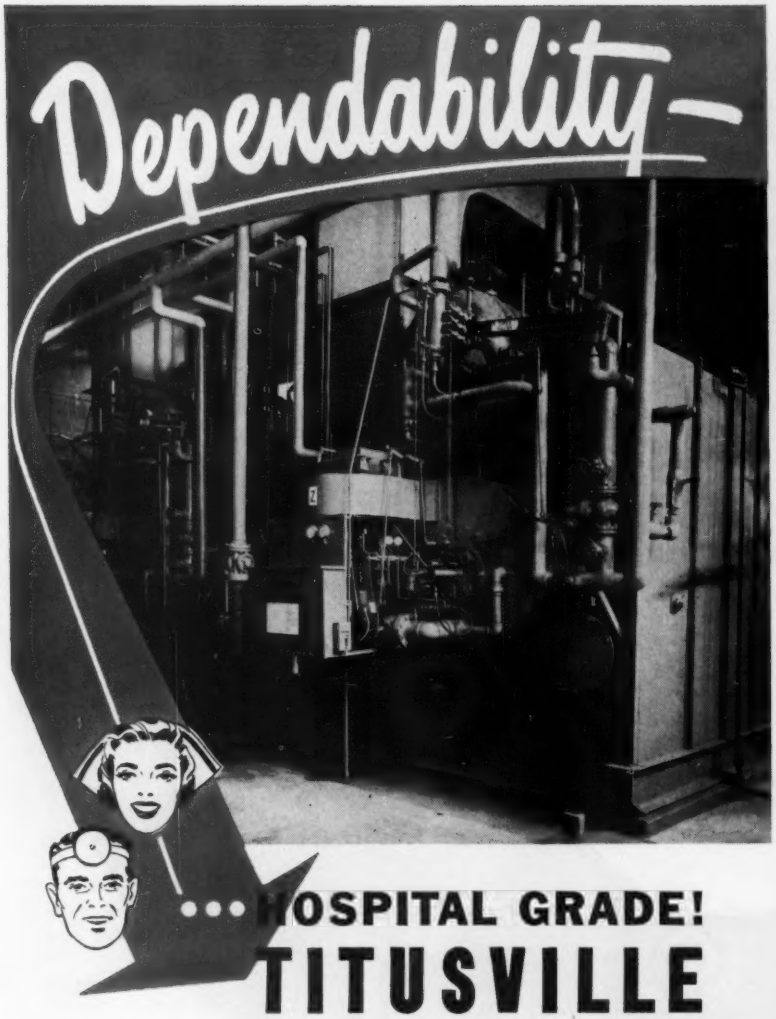
The Package Ljungstrom operates on the continuous regenerative counter-flow principle. The heat-transfer surfaces on the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming combustion air.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.



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More TECHNICAL BRIEFS

Begins on page 156

temperature above the allowable maximum of 105 C.

The core, bearing, and windage losses of an induction motor are relatively constant, whereas the copper losses are variable and comprise the greater portion of the total losses on overload. The current causing this copper loss is then an accurate measure of the motor temperature under normal conditions of ventilation; hence, the majority of industrial thermal relays are current operated. This discussion is primarily concerned with the application of current-sensitive thermal relays for the protection of polyphase integral-horsepower squirrel-cage induction motors. *AIEE paper No. CP 55-470.*

Smokestacks

Factors influencing the dynamic behavior of tall stacks under the action of wind. *By M S Ozker and J O Smith, The Detroit Edison Co.*

Tall stacks vibrate under the action of steady winds. Direction of this vibratory motion is normal to the wind direction. The stack structure under wind action constitutes a self-excited vibrational system. Vibration frequency is the natural frequency of the structure and remains constant for all wind velocities.

Stack is at resonance at all times. There is no critical wind velocity in the sense of forced vibrational response. The amplitudes increase with wind velocities. *ASME paper No. 55-A-69.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.

The Pelton Water Wheel Co, subsidiary of Baldwin-Lima-Hamilton Corp, has been awarded a contract by the Pacific Gas & Electric Co to furnish two 76,000-hp vertical-shaft reaction-type hydraulic turbines and auxiliaries for the Poe hydroelectric project on the Feather River.

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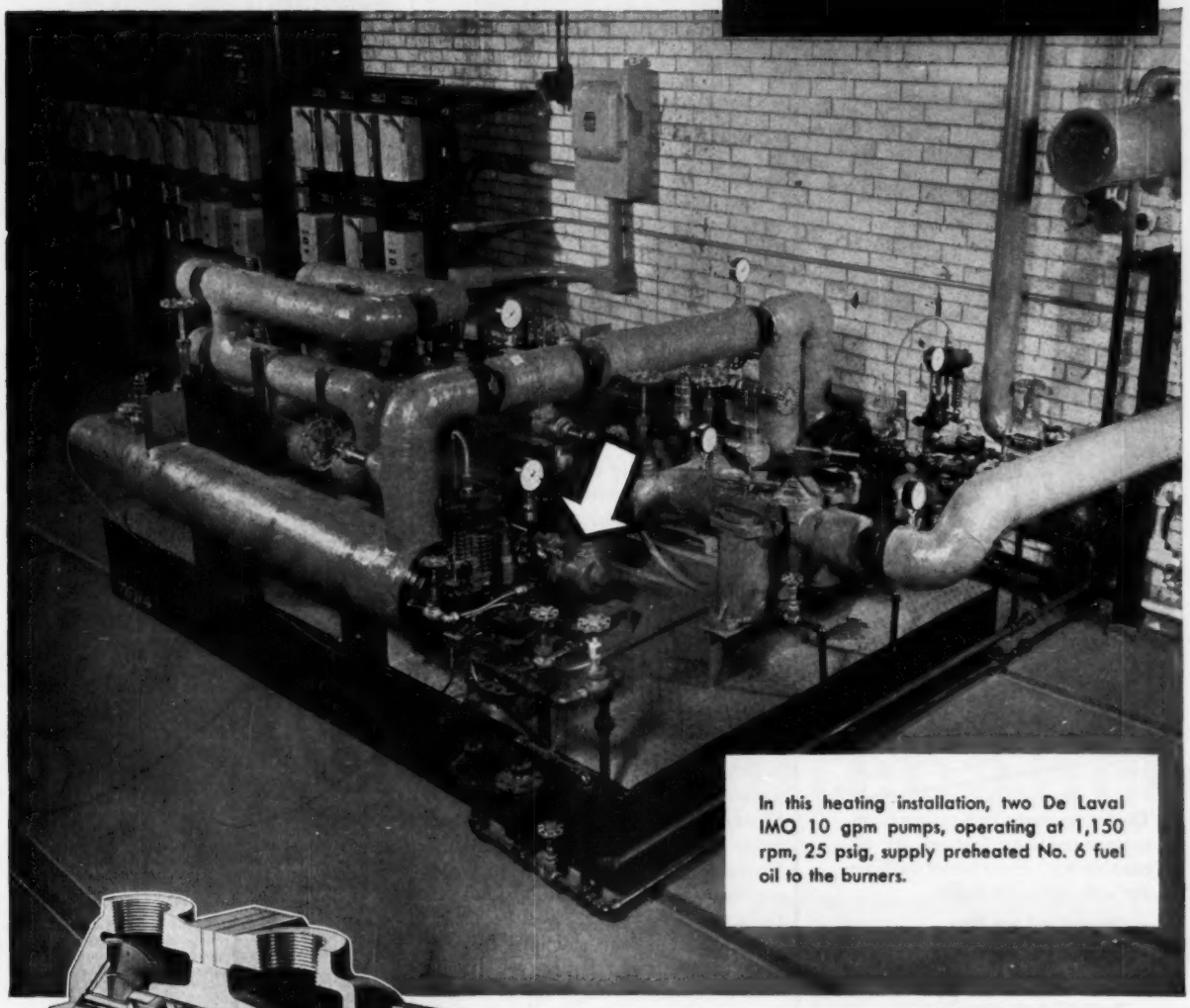
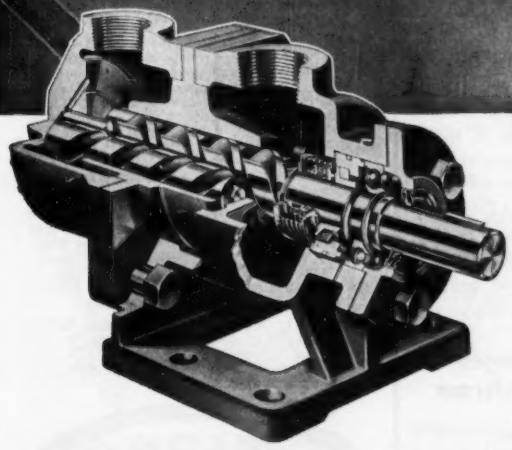


In this heating installation, two De Laval IMO 10 gpm pumps, operating at 1,150 rpm, 25 psig, supply preheated No. 6 fuel oil to the burners.



A wide range of De Laval IMO models specifically built for fuel oil service is available. Capacities up to 80 gpm, pressures to 275 psig. Write today for Bulletin LG-A.

To increase your present—and future—profits on commercial heating jobs, install *dependable* De Laval IMO pumps on pump and heater sets. Their simple, trouble-free design saves you money on service calls . . . builds customer goodwill, for there's nothing to get out of order or need adjustment. No pilot gears, no sliding vanes, no reciprocating pistons. De Laval IMO's have only three moving parts—smoothly intermeshing rotors that propel the fluid axially in a steady flow without churning, pocketing or pulsation.

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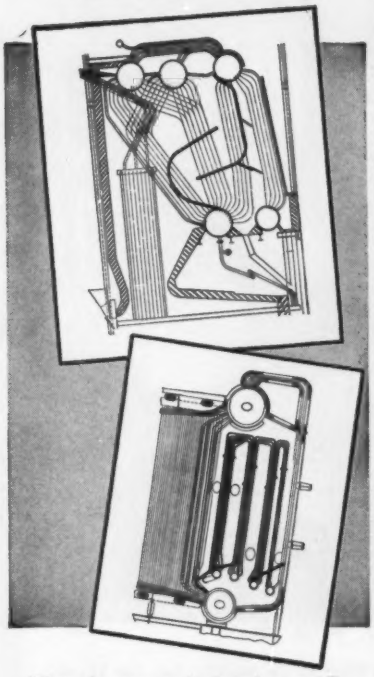

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REPORTS from the FIELD

Begins on page 154

He will head the development of the Institute's solar energy research program in cooperation with the Association for Applied Solar Energy.

Mr Yellott will be located in Phoenix, Ariz., operating out of SRI's Mountain States Division offices there. A native of Maryland, he has bachelor's and master's degrees in mechanical engineering from Johns Hopkins University. During twelve years in engineering education and industrial research he taught at the University of Rochester, Stevens Institute of Technology and Illinois Institute of Technology.

Mr Yellott holds twenty-five U.S. and foreign patents on inventions ranging from super-sonic sound generators to coal pulverizers and flyash separators. Author of numerous technical papers, he has edited engineering textbooks and contributed to the Encyclopedia Brittanica and Perry's Chemical Engineering Handbook.

He is a fellow of the American Association for Advancement of Science, a member of the American Society of Mechanical Engineers, Alpha Delta Phi, Sigma Xi, Tau Beta Pi and Pi Tau Sigma.

21 technical sessions slated for AWS Spring Meeting

► PAPERS ON WELDING nuclear reactor components, a special session on safety, health and fire prevention and four sessions sponsored by the ASME Metals Engineering Division, are some highlights of the coming 1956 National Spring Meeting of the American Welding Society. The event will be held in Buffalo, N. Y. during the week of May 7.

A program of 21 technical sessions has been planned. Papers will range from technical reports on latest welding research to practical reviews of where and how welding is being successfully applied in industry.

For the first time the Metals Engineering Division of the American Society of Mechanical Engineers will meet with AWS and sponsor papers of parallel technical interest to both groups.

Moloney Electric ships largest 3-phase single-core transformer

► MOLONEY ELECTRIC CO has recently built and shipped to a Southwestern utility a dry-type transformer believed to be the largest 3-phase single-core unit ever constructed.

This transformer is rated 4000 kva, 13.200 volts Delta primary with 2-2½% full capacity taps above and below nor-

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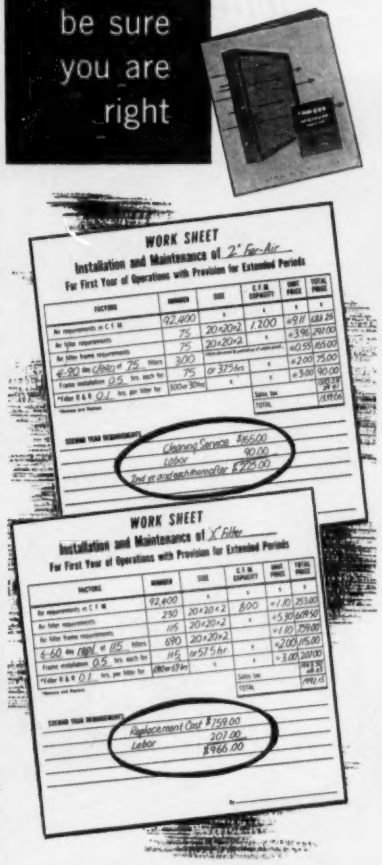
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Because most filters are efficient at cleaning air, you are reasonably sure of getting a satisfactory job when you install an established make. The service life of your expensive air conditioning machinery and the comfort of your building depend on the ability of relatively low cost filters to do their job.

FARR Company, as one of the country's leading filter manufacturers, wants to insure that you are getting the most value out of your present filters, regardless of make. Therefore, they will send a field engineer who is an air filtration expert, to carefully analyze your air filters and submit a factual, written report like the one shown, on his findings. Often he can make suggestions that will greatly increase your filtration efficiency and save you a substantial amount of money in operating costs.

FARR Company is making this service available to you on a no cost basis because it will increase your appreciation for the function of the often-neglected air filters. It will point out the importance of buying standard brand filters. It will in some cases result in sales for FAR-AIR filters . . . and that is important, too.

Why not try this service? It is factual, honest and subject to favorable comparison by any reputable manufacturer. Write today to Farr Company, P. O. Box 45187, Airport Station, Los Angeles 45, California.

FARR COMPANY

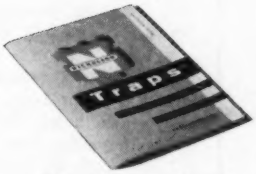
NO COMPROMISE ON QUALITY

Los Angeles, New York, Chicago

New Orleans

Nicholson *steam trap* simplicity *gives you*

peak performance, low-cost maintenance



Write, today, for your copy of new Bulletin 10-55—for detailed information.

Nicholson simplicity of design and operation pays off big in any plant . . . in greatest efficiency of steam distribution . . . in easy, low-cost maintenance. Nicholson traps offer the most effective method for discharging condensate and air from steam lines.

- **one moving part—big husky bellows.**
- **positive shut-off—no waste of steam.**
- **high capacity—effective use of large orifice.**
- **each unit service tested—with steam.**

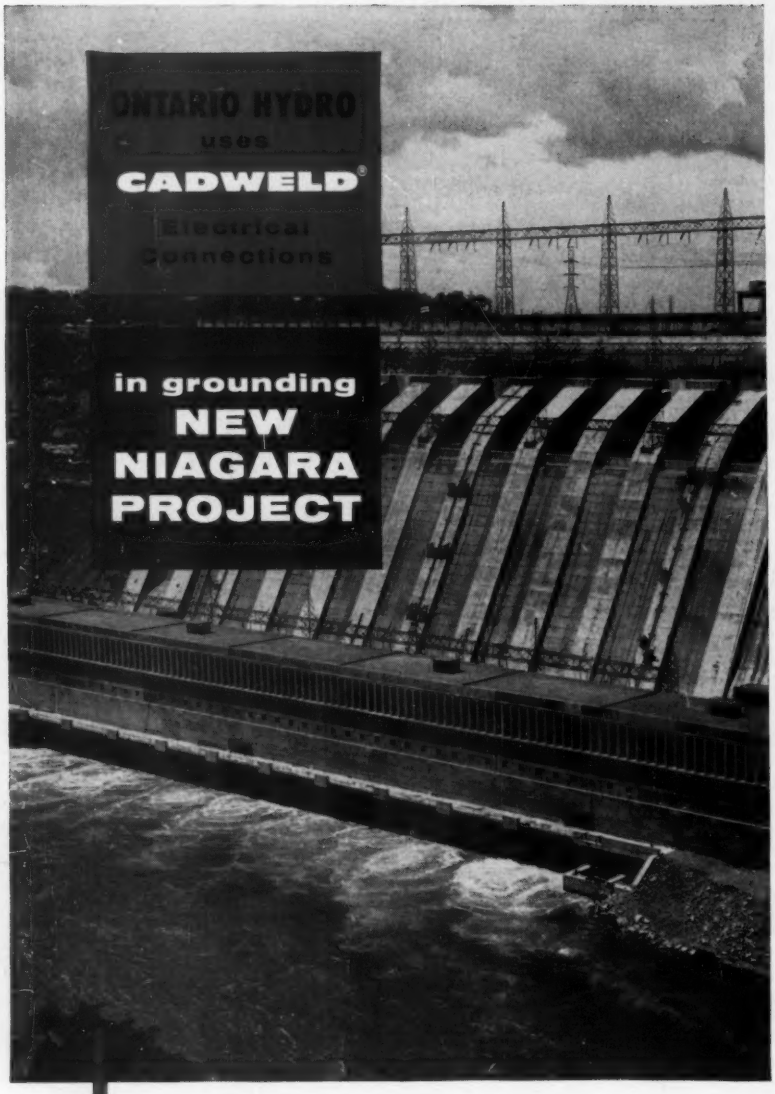
When less than the best won't do, specify Nicholson.

NICHOLSON

W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS
LAUNDRY, DRY CLEANING AND PRESSING MACHINERY

14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 98 PRINCIPAL CITIES



Illustrated is the 12-unit phase (1,200,000 horsepower) of the new SIR ADAM BECK-NIAGARA Generating Station No. 2 on the NIAGARA RIVER. The overall development will have an ultimate installed capacity of 1,828,000 horsepower. GROUNDING connections in the powerhouse and switchyard areas are CADWELD—the permanent electrical connections that cannot loosen or corrode and eliminate maintenance.

CADWELD®

Erico Products, Inc.

2070 E. 61st Place • Cleveland 3, Ohio

IN CANADA: ERICO INCORPORATED, 3571 Dundas St., West, Toronto 9, Ontario

REPORTS from the FIELD

Begins on page 154

mal and 2400 volts Delta secondary. Provision has been made for the future addition of forced-air-cooling equipment to increase transformer capacity to 5333 kva. Fan control will be from winding temperature relays.

Removable panels allow easy access to primary terminal boards for tap adjustments. In addition, a control panel housing the winding temperature relay alarm circuit and latch relays for alarm and trip circuits is mounted on the front of the enclosure to permit ease of inspection.

Total weight of assembled transformer and cubicle is 33,500 lb. Overall height is 138 in. and floor space occupied is 68 x 122 in.

Calendar of Events

Feb 13-17—American Society of Civil Engineers, National Winter Convention. Baker Hotel, Dallas, Texas. Details from ASCE, 33 W 39th St, New York 18, N. Y.

Mar 8-9—American Institute of Electrical Engineers, Conference on Electrical Engineering As Applied to the Paper and Pulp Industry. University of Florida, Gainesville, Fla. Full details from AIEE, 33 W 39th St, New York 18, N. Y.

Mar 12-16—National Association of Corrosion Engineers, 12th Annual Corrosion Conference. Hotel Statler, New York. Full information from NACE, 1061 M & M Building, Houston 2, Texas.

Mar 15-16—American Institute of Industrial Engineers (Cleveland Chapter), 5th Annual Spring Conference. For information write, W S Ritchie, AIIE, Room 330, Cuyahoga Savings Building, 2123 E 9th St, Cleveland 15, Ohio.

Mar 18-21—American Society of Mechanical Engineers, Spring Meeting. Multnomah Hotel, Portland, Ore. Complete information from ASME, 29 W 39th St, New York 18, N. Y.

Mar 19-20—Steel Founders' Society of America, Annual Meeting. Drake Hotel, Chicago. Details from SFSA, 606 Terminal Tower, Cleveland 13, Ohio.

Mar 21-23—American Power Conference, 18th Annual Meeting. Sponsored by Illinois Institute of Technology in cooperation with 13 universities and nine national and regional technical societies. Hotel Sherman, Chicago. Details from IIT, 35 W 33rd St, Chicago 16, Ill.

Apr 2-4—American Society of Electrical Engineers, South West District Meeting. Dallas, Texas. Details from AIEE, 33 W 39th St, New York 18, N. Y.

(*Continued on page 236*)

. . . there's enough difference to make ALL the difference

This is just one inspection of extrusion dies through which a cast billet heated to a rigidly controlled temperature is hot extruded into a "tube shell" . . . from which Scovill Heat Exchanger Tube is subsequently cold-drawn.

One of the most highly skilled and critical jobs in the process is that of finishing and maintaining these dies. The smooth, clean surfaces of resulting shells are essential assurance of highest quality in finished tubes.

It is needless to tell Scovill customers that, while *correct alloy selection* is important to efficient exchanger operation, of equal importance is the *uniformity and soundness of tubes* themselves. Scovill Technical Service and tube production methods, considered by many the very best in the industry, can give you complete assurance on both these essential counts.

Scovill Heat Exchanger Tube is available in a comprehensive range of standard alloys (listed below).

Scovill Manufacturing Company, Mill Products Division,
99 Mill Street, Waterbury 20, Connecticut. Phone Plaza 4-1171.

SCOVILL **HEAT EXCHANGER TUBE**

Phosphorized Admiralty • Admiralty • Arsenical Admiralty • Muntz Metal • Naval Brass • Red Brass, 85% • Deoxidized Copper
Arsenical Copper • Copper Nickel, 10% & 20% • Cupro Nickel, 30% • Aluminum Brass • Aluminum Bronze, 5% • Duplex Tube

1ac88

Stop Corrosion

in boilers, steam and return lines . . .

with this Stickle deaerating feed water heater

SAVES STEAM
Vent Condenser releases only air and contaminated gases to atmosphere
NO CONTAMINATION
Counterflow of steam and water prevents reabsorption of oxygen
SELF-CLEANING
There is no need for removable baffles or trays

Stickle Baffle Spray Type Deaerating Feed Water Heaters stop corrosion by removing destructive oxygen and carbon dioxide from boiler feed water . . . reduce fuel costs and boiler strain. Vertical and horizontal models. Capacity range: 3,000 to 300,000 pounds per hour. The latest development in more than 50 years of building feed water heaters.

FREE CATALOGS!

S-217 . . . Baffle Spray Type Deaerating Feed Water Heaters
117 . . . Open Coil Feed Water Heaters

STICKLE STEAM SPECIALTIES CO.
2265 Valley Ave. • Indianapolis 18, Ind.

Stickle Equipment
Cuts the cost of steam

REPORTS from the FIELD

Begins on page 154

Apr 10-12—Metal Powder Association, 12th Annual Meeting and 1956 Metal Powder Show. Hotel Cleveland, Cleveland, Ohio. Details from MPA, 420 Lexington Ave, New York 17, N. Y.

Apr 16-18—American Society of Electrical Engineers, Great Lakes District Meeting. Fort Wayne, Ind. Details from AIEE, 33 W 39th St, New York 18, N. Y.

N. J. utility company announces expansion plans

► PLANS FOR A NEW electric generating station on Overpeck Creek, Ridgefield, N. J., have been announced by Lyle McDonald, chairman of the board of Public Service Electric and Gas Company. Total cost of the project, including transmission facilities, is estimated at about $129 million. Work is scheduled for completion in 1958.

Another electric generating station is under construction in Linden, N. J., adjacent to the Bayway Refinery of Esso Standard Oil Co. This project, including transmission facilities, is estimated to cost upwards of $100 million and is scheduled for completion in 1957.

Overpeck Creek station will have two turbine-generator units—each of 275,000-kw capacity. Linden station will have two turbine-generators of 225,000-kw each.

The week of February 5, 1956 has been designated as National Electrical Week. It will be observed annually as a coordinated project under the sponsorship of all major segments of the electrical industry.

Contract awarded to The Fluor Corp, Ltd, calls for engineering and construction of a 4000 barrel per-stream-day fluid coking unit for Banking Oil Co at its Bakersfield, Calif. refinery.

Five-hundred acres of land along the Ohio River, just north of Clarington, Ohio, has been acquired by Ohio Power Co for the site of a future 1,000,000-kw steam-electric generating plant.

1955 Edison Medal has been awarded to Leonid A Umansky, manager of engineering, Industrial Engineering Dept, General Electric Co. Mr Umansky, 45th winner of the medal, was cited "for his outstanding contribution to the electrification of industry through the application of electrical machines, devices and systems to automatic process machinery; and for his inspiration, leadership and teaching of men in this work."

Dr Jesse E Hobson, director of Stanford Research Institute since March 1948, has submitted his resignation effective March 31.

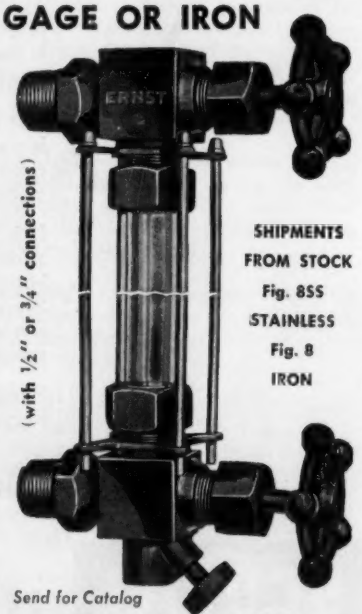
The Greater the Pressure . . . the Tighter It Holds!

There's still nothing simpler or more efficient in power line service than this Wilcox Self-Sealing Gasket which has served industry so well over the years. The U-shaped metal outer cover is packed with a resilient filling (usually rubber or asbestos). Pressure exerted on this elastic filling forces it into the cover, putting force against the adjacent flange surfaces. Thus, internal pressure that tends to blow ordinary gaskets makes the Wilcox Gasket tighter in the joint. Available with covers of copper, lead, tin, aluminum, monel, stainless steel, etc. in all sizes—standard or special.

Write for details and quotations

CHICAGO-WILCOX MFG. CO.
7707 So. Avalon Ave.
Chicago 19, Ill.

ERNST
STAINLESS STEEL GAGE OR IRON

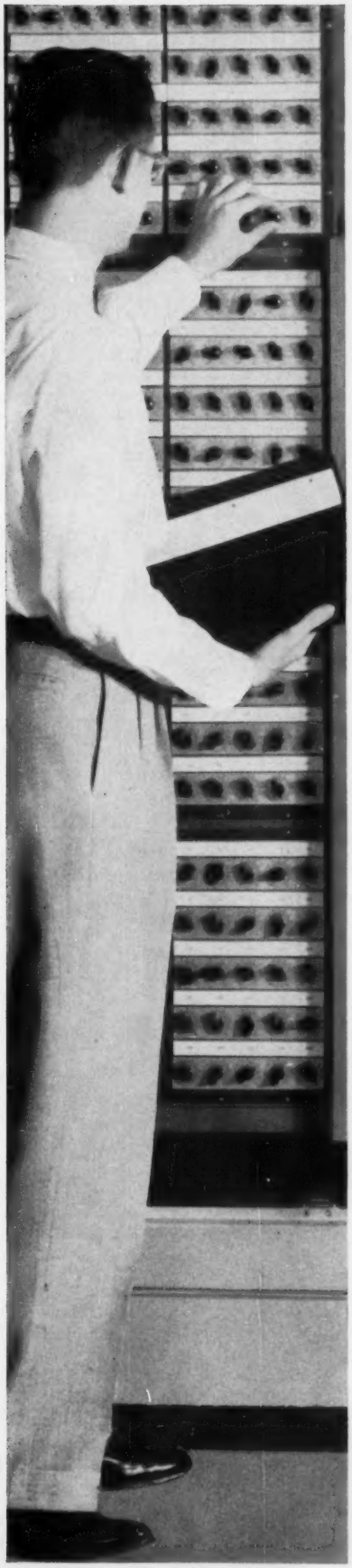


(with ½" or ¾" connections)

SHIPMENTS FROM STOCK
Fig. 8SS STAINLESS
Fig. 8 IRON

Send for Catalog

Phone Livingston 6-1400
ERNST WATER COLUMN & GAGE CO.
LIVINGSTON, N. J.



Panalog Information Systems guide management in raising plant output and profit

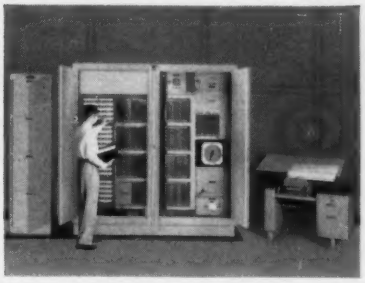
Panalog 605 Information System supplies management control information. Now, operating personnel and management can receive organized digital information on any process, instantly and continuously. Information can be presented in a variety of forms for immediate control action as well as for engineering and accounting analysis. A typical presentation method employs an electric typewriter and patented log chart. Readout can also be made on punched or magnetic tape, punched cards, or can be fed directly to computers.

Periodically logs and continuously scans. A precision servo measuring system quantizes process variables during automatic, periodic logging. A high-speed electronic measuring system detects off-normal conditions during continuous scanning of all variables. Normal and return-to-normal values are printed in black—off-normals in red. A complete log of all variables as well as a summary of off-normals can be made at any time.

Completely flexible and expandable. Panalog components are standardized, packaged modules. The system can be easily expanded or modified in the field. The Panalog 605 is sufficiently flexible to supply digital information for any management requirement.

Write for literature. Literature presenting a comprehensive treatment of the Panalog 605 is available. If you wish, a Panellit representative in your area will be happy to discuss the possibilities that a Panalog Information System offers your company.

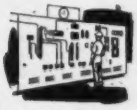
Full scale, adjustable, high and low off-normal limits are provided for each input variable. Basic system capacity, 200 points with one electric typewriter — can be expanded. Accuracy, ±.25% of full scale range. Logging speed, approximately one line per minute. Scanning speed, five points per second, between logs.



Logged values are grouped by processing unit on chart. Audio-visual alarms accompany detection of off-normals. When scanning, off-normal values are identified and printed in separate chart area. Totalized and averaged values as well as plant efficiencies can be automatically computed and recorded by the system.

U.S. Pat. No. 2,701,748

Engineered Information Systems For Industry



Graphic Panels Control Centers

Panalarm Annunciators

Instrument Services Division

PANELLIT

PANELLIT, INC.

7417 N. Hamlin Ave., Skokie, Ill.
Panellit of Canada Ltd., Toronto 14

American
ROLLING RING
COAL CRUSHERS
COAL IS SPLIT -NOT CRUSHED

for More Uniform
COAL
PREPARATION
Proved by Hundreds of Millions of Tons of Reduced Coal.
Coal Crushers up to 800 TPH
Sample Crushers up to 15 TPH
COAL PREPARATION PROBLEM?
Write for Recommendations and Literature.
American
PULVERIZER COMPANY
1349 MACKLIND AVE. • ST. LOUIS 10, MO.

APPOINTMENTS

Corporation executive changes

Elgin Softener Corp: Corwith Hamill, president. **Robertshaw-Fulton Controls Co:** Woodford D Miller, executive vice-president in charge of eastern operations; Frank H Post, vice-president and general manager of thermostat division. **American Air Filter Co, Inc:** W M Reed, chairman of the board; W G Frank, president. **U.S. Rubber Co:** Herbert M Kelton, director and vice-president.

Warren Steam Pump Co, Inc: Donald B Gilman, executive vice-president and treasurer. **Baltimore & Ohio Railroad Co:** Douglas C Turnbull Jr, vice-president, research and development; Lloyd W Baker, executive assistant to the president. **Burns and Roe, Inc:** L F A Mitchell, vice-president.

Henry J Kaiser Co: Paul C Meyer, vice-president, responsible for administrative activities of Kaiser Engineers Division and its subsidiaries. **Chase Brass & Copper Co, Inc:** George B Mosely, vice-president, sales. **Glen Alden Corp:** Sheldon P Wimpfen, vice-president.

Operations executive changes

Westinghouse Electric Corp: William L Borden, assistant to vice-president, atomic power activities. **The Fluor Corp, Ltd:** M S Umbenhauer, manager of power-plant design. **Downington Iron Works:** W L Killen, works manager of fabricating plants; William F Keehn, manager of product development.

American Gilsonite Co: Lee Morris, manager of operations; John H Henderson, chief engineer of operations; Jesse L Boyce Jr, refinery superintendent—all at company's new coke refining plant, Grand Junction, Colo. **Bell & Gossett Co:** Lee Wilson, manager of air compressor division.

New sales managers

Allis-Chalmers Manufacturing Co: Herbert K Kingsbury, product sales, centrifugal pump section, Norwood Works. **Formsprag Co:** Kenneth M Kraska, West Coast district. **Baldwin-Lima-Hamilton Corp:** C G Crawford, hydraulic turbines and related equipment. **Cobell Industries, Inc:** W F Wright Jr, gas air-conditioning division. **L O F Glass Fibers Co:** Don W Lyon, textile division. **Harbison-Walker Refractories Co:** John R Hewitt, Boston territory. **Worthington Corp:** R K Grobholz, power pump division.

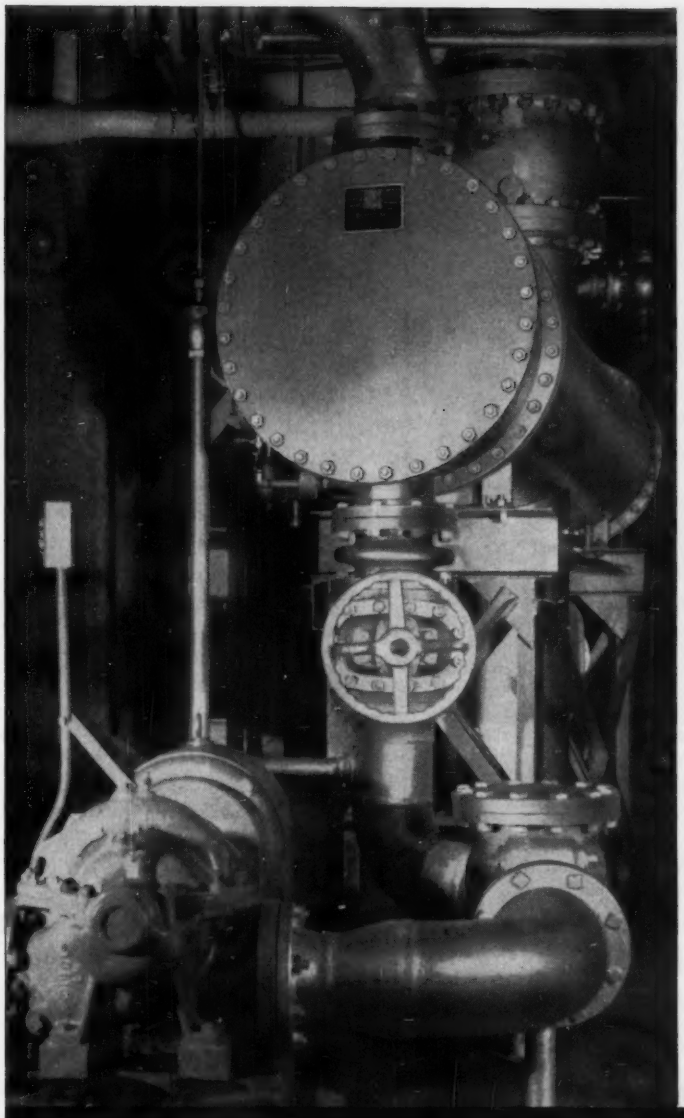
New representatives

For Morris Machine Works: Cross Pump & Equipment Co, Charleston, W. Va. **For A W Cash Co:** J W Cherry

ON DUTY...

in Connecticut State Hospital's power plant

ROSS SURFACE CONDENSER



With a staff of 982 employees and care facilities for 3,016 patients, the Connecticut State Hospital, Middletown, Conn., is one of numerous institutions, public utilities, office buildings, refineries and other industries served by Ross Surface Condensers. Here, the Ross unit condenses the exhaust from a 500 kw turbine generator set, producing 26 in. Hg. vacuum.

Because it has engineered and built so many condensers: standardized, special and packaged units . . . because it has originated so many "firsts" in condenser design, Ross is uniquely qualified to be of maximum service in planning, designing and fabricating surface condensers for your requirements.

Why not consider Ross in your next installation? Word from you will bring a qualified representative to your plant with valuable data on surface condensers and exchangers, whatever your requirements may be.

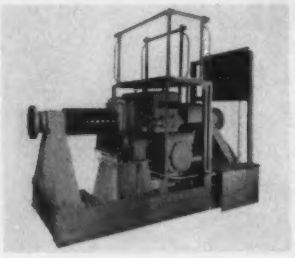
ROSS HEAT EXCHANGER DIVISION
of
American-Standard
1473 WEST AVENUE • BUFFALO 13, N. Y.
In Canada: Kewanee-Ross of Canada Limited, Toronto 5, Ont.

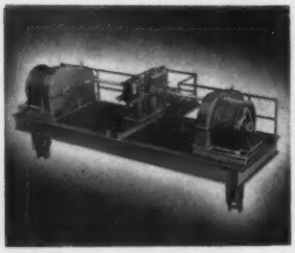
Pioneer of all-welded steel surface condensers

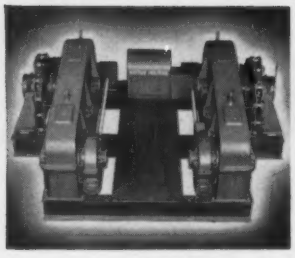
ROSS

ROSS HEAT EXCHANGER PRODUCTS

Murco
GATE HOISTS!
for any Size Power Dam







Top illustration is the 25-ton MURCO Gate Hoist delivered to Kansas City Power & Light Company, Kansas City, Missouri.

MURCO Gate Hoists are designed and built in a wide range of capacities—for any size power dam—from less than one ton to over 100 tons . . . from the smallest hand operated to the largest motor operated gate hoist. Back of every MURCO Gate Hoist is over 70 years of designing and building, and from this experience we have accumulated designs and patterns that may fit your requirements. In planning gate hoists we suggest you write us before your plans for the project as a whole are completed.

Write for complete information and engineering recommendations.

D. J. MURRAY MANUFACTURING CO.
Manufacturers Since 1883
WAUSAU · WISCONSIN

More APPOINTMENTS

Begins on page 238

Co, 150 Olive, Box 4117, Shreveport, La. For **Conoflow Corp:** The Ernie Graves Co, Tulsa, Okla.

For **Feedrail Corp:** Glenn & Larson, 123 Brevard Court, Charlotte 2, N. C. 918 Langford Bldg, Miami 32, Fla. and at 172 Simpson St, SW, Atlanta 13, Ga.; Robert S Morrison, 1028 7th Ave, S, Birmingham, Ala.; E J Hagan, 3820 Louisiana Ave, New Orleans 25, La.; James M Tuite, 1802 Corona St, Dallas 14, Texas; and Reitze & Co, 2209 S Floyd St, Louisville 17, Ky. For **Simpson Electric Co:** E A Dickinson & Associates, 744 N 4th St, Milwaukee 3, Wis. For **Centric Clutch Co:** Stanley M Proctor Co, 1900 Euclid Ave, Cleveland 15, Ohio.

Recent mergers

Walworth Co and **Conoflow Corp,** with Conoflow becoming an operating subsidiary of the Walworth Co. **Square D Co** and **Electric Controller & Manufacturing Co:** Square D, as the surviving company, will operate Electric Controller as a separate division. **Pyrene Manufacturing Co** and its wholly-owned subsidiary. **C-O Two Fire Equipment Co:** corporate merger and adoption of a new name, Pyrene —C-O Two Corporation.

Recent moves

United States Rubber Co: Washington, D.C. office to 1700 K St, NW, suites 1001 and 1002. **West Penn Power Co:** general offices to new building at Cabin Hill, Greensburg, Pa. **Johnson Service Co:** branch office from Newark to 1126 Morris Ave, Union, N. J.

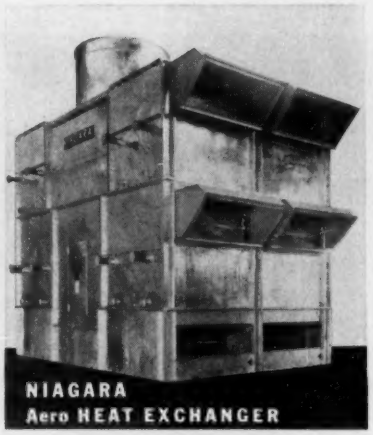
T J Cope, Inc and its wholly-owned division Instrof Corp: manufacturing operations to Collegeville, Pa. **Rohm & Haas Co:** San Francisco office to Pacific Mutual Bldg, 600 California St; and Atlanta, Ga. office to 1428 Peachtree St, NW.

New branch offices

American Blower Co: in Youngstown, Ohio, J R Hopkins, manager; in Wichita, Kan., O J DuPree, manager; in San Antonio, Texas, W F Markey, manager; in Evansville, Ind., J B Clayton, manager; and in Nashville, Tenn., B G Kemp, manager. **Graver Water Conditioning Co:** at 17590 James Couzens Highway, Detroit, Mich. **Arthur D Little, Inc:** in Suite 606, Cafritz Bldg, 1625 Eye St, NW, Washington, D.C.

Cook Electric Co: at 21015 Lorain Ave, Fairview Park, Cleveland 26, Ohio, Edward Bock, manager; and at 401 Basset Tower, El Paso, Texas, Richard A Mayes, manager. **The Texas Co,** technical service division: at 873 Spring St, NW, Atlanta, Ga., J F Collins Jr, manager. (*Continued on page 242*)

THIRTY MILLION B.T.U. CAPACITY
with Precise Control of Temperature in Cooling



The NIAGARA Aero HEAT EXCHANGER cools liquids and gases by evaporative cooling with atmospheric air, removing the heat at the rate of input, controlling temperature precisely. You save 95% of cost of cooling water; you make great savings in pumping, piping, power; quickly recover your installation cost.

You can cool and hold accurately the temperature of all fluids, air and gases, water, oils, solutions, chemical intermediates, coolants for mechanical, electrical and thermal processes. You obtain closed system cooling free from dirt. You solve all the problems of water availability, quality or temperature.

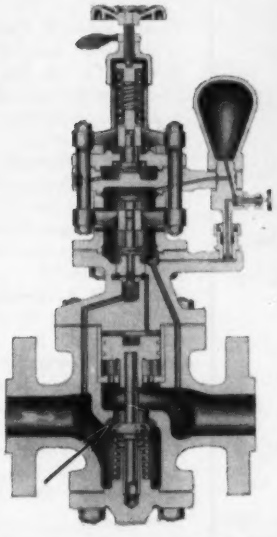
In CHEMICAL PROCESSES this is successfully used in cooling liquids and gases, chemical reactions, condensing distillations and reflux cooling.

Write for complete information; ask for Bulletins 120 and 124. Address Dept. P

NIAGARA BLOWER COMPANY
405 Lexington Ave., New York 17, N.Y.
District Engineers in Principal Cities of U. S. and Canada

STELLITE'S *IN* EROSION'S *OUT*

No Erosion Here!



Arrow shows location of integral stellited seating surface in Leslie Pump Pressure Regulator.

Stellite as a *standard* seating surface for regulators and control valves in steam service is a Leslie exclusive. Combined with a hardened stainless steel main valve, stellite provides the most erosion resistant combination known, and is available in integral and renewable seating arrangements.

This unbeatable combination, pioneered in the field by Leslie, is the product of many years' experience and knowledge of proper stelliting and heat treating techniques. And with Leslie, it's *standard* in a wide range of regulators and control valves designed to meet any temperature or pressure requirements.

When erosion and wear are factors to consider, it will pay you to call your Leslie engineer to demonstrate how, with Leslie equipment, "Stellite's In — Erosion's Out".

TRADE LESLIE MARK

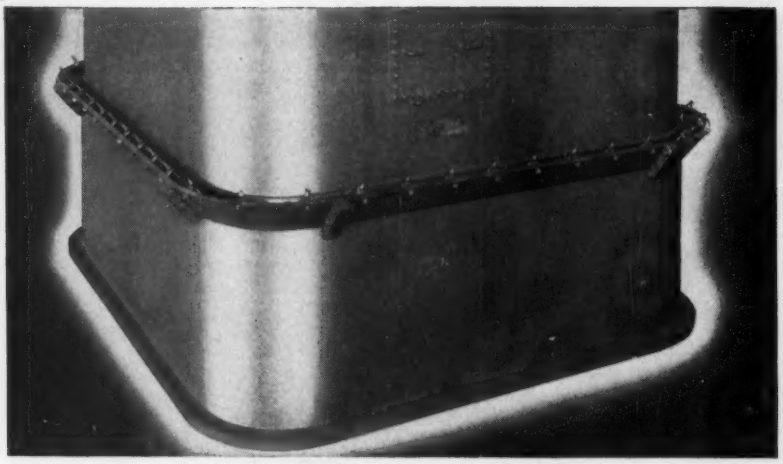
Write for Bulletin 552
"When To Use A Controller And When To Use A Regulator".

REGULATORS AND CONTROLLERS

LESLIE CO., 235 GRANT AVENUE, LYNDHURST, NEW JERSEY

9572

CONTROLLED QUALITY MEANS QUALITY CONTROLS

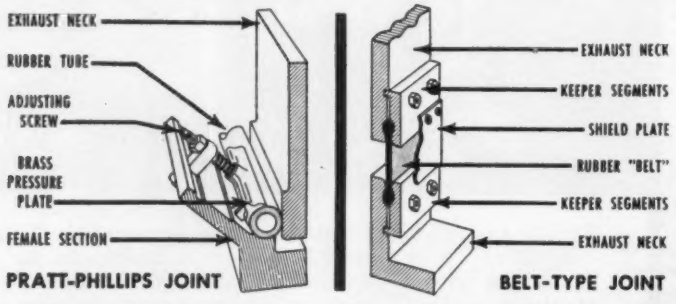


simple-flexible

TURBINE-CONDENSER EXPANSION-JOINTS

Pratt-Phillips joint is ideal flexible connection. Absolutely air-tight under vacuum and steam-tight under exhaust conditions, it is easily installed and sets up no undue strains in the turbine casing.

Rubber element provides flexibility in all directions. The rubber sealing member is held under compression by pressure plates. Protected from oil and sunlight, it lasts for many years. The exclusive Pratt-Phillips design exposes only one-twelfth of the rubber surface to steam.



Easy to install or replace. The rubber element can be installed, removed or replaced in less than three hours on even the largest joints. No special rubber shapes are required; the same type is used on round or rectangular stacks.

Other types of joints available. For installations where space is limited, the belt-type expansion joint is advantageous since it requires no more space than the exhaust stack itself.

The Henry Pratt Company offers complete engineering and manufacturing facilities for exhaust stacks and joints, flues, ducts, butterfly valves and other power plant equipment.

Our engineers can help with your problems...write for full details.

HENRY PRATT

POWER INDUSTRY EQUIPMENT

TURBINE-CONDENSER

Expansion Joints

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill.

More APPOINTMENTS

Begins on page 238

Association elections

National Association of Corrosion Engineers: W F Fair Jr, president; W H Stewart, vice-president; R A Brannon, treasurer. **National Lubricating Grease Institute:** W M Murray, president; J W Lane, vice-president; A J Daniel, treasurer. **American Standards Association:** H Thomas Hallowell Jr, president; Van H Leichliter, vice-president.

Retirements

Jean V Giesler, executive vice-president of Robertshaw-Fulton Controls Co. after almost 43-years of continued service. He will continue to serve as a consultant for the company.

William W Shuttleworth, executive vice-president and treasurer of Warren Steam Pump Co, after 46-years of service. He will continue to serve on the company's board of directors.

Vernon D Armstrong, executive engineer for the Sierra Pacific Power Co, after 30-years of service.

Obituaries

Frank Edward Payne, 72, chairman of the board and co-founder of Crane Packing Co, on Nov 20.

Christian Steenstrup, 82, retired refrigeration consultant for General Electric Co, on Nov 29.

Marshall L Hough, 56, president and treasurer of Darling Valve & Manufacturing Co, on Dec 7.

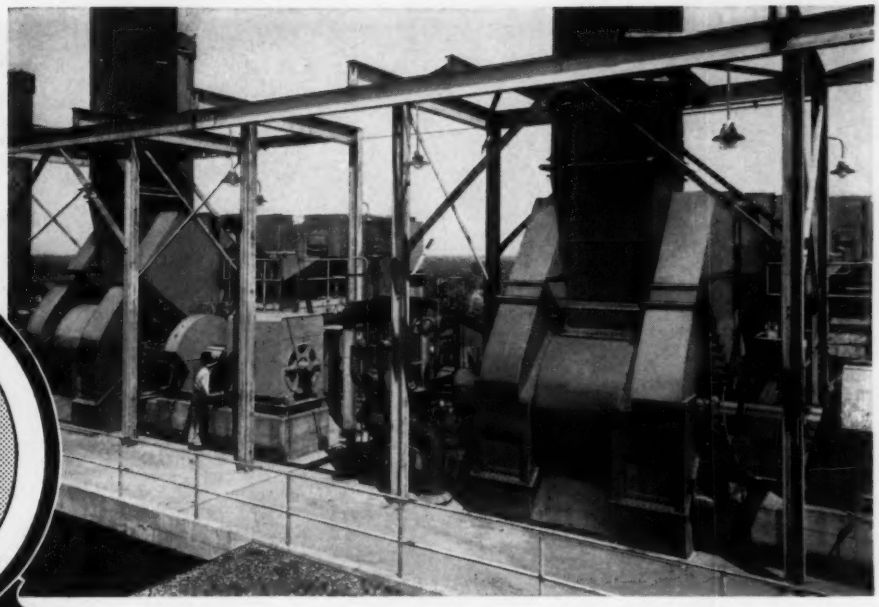
James McElgin, 54, manager of metalworking department of E F Houghton & Co, on Dec. 7.

Horace P Liversidge, 77, chairman of the board of the Philadelphia Electric Co, on Dec 8.

James E Power, 65, former manager of national accounts and trade relations for the mechanical goods division, U.S. Rubber Co, on Dec 17.

Edward D Youmans, 58, vice-president in charge of research and product development, The Okonite Co, on Dec 18.

"Personnel sent him down as a lab man."



MARATHON

chooses marathon performers in the mechanical draft field

Clarage Fans Installed at Ohio Oil's Refinery, Robinson, Ill.

"Best in the long run" is Marathon's slogan for its gasoline. But there's growing opinion that these five words aptly describe Clarage equipment as well.

For example, Ohio Oil's $3,500,000 improvement and expansion program for their power plant required the removal of Clarage induced draft fans which had been on the job continuously since 1926. Think of it, nearly 30 years of service under the most punishing conditions a fan can encounter. Value received — in full!

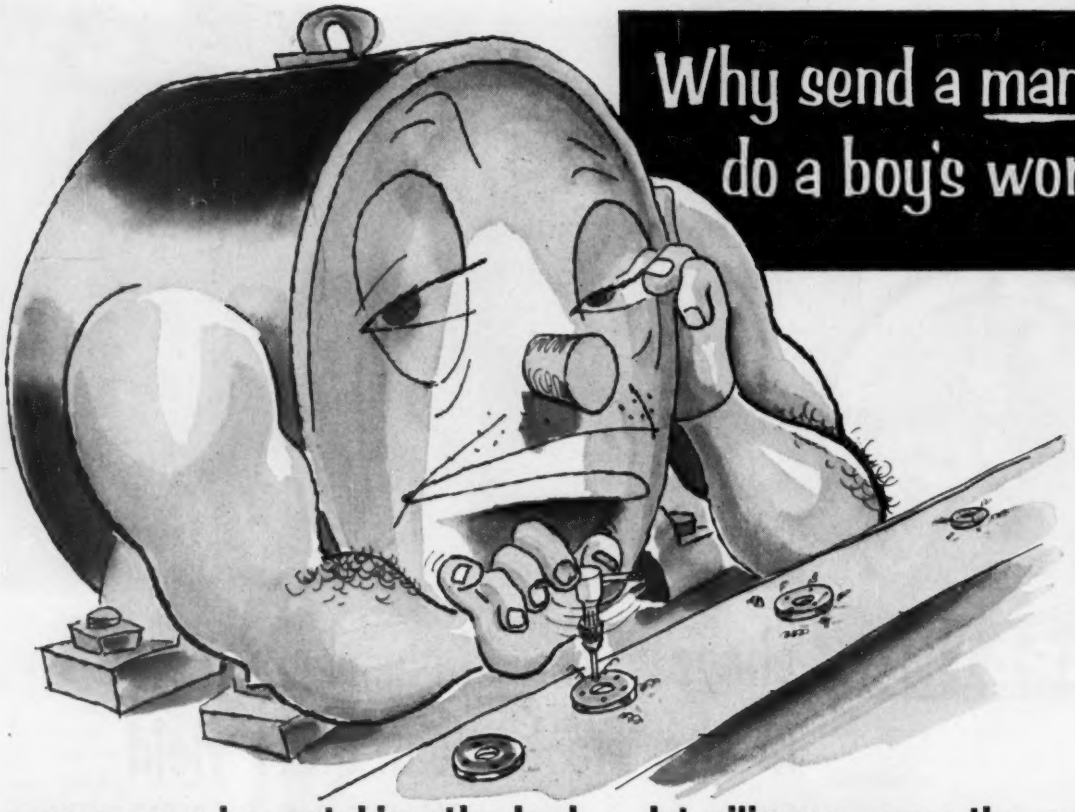
Small wonder that two Clarage Type RT induced draft fans and two Clarage Type W forced draft fans were selected to serve the two 180,000 lbs. per hour Riley boilers in the modernized plant.

These fans are installed outdoors on an elevated platform, and are equipped with dual drives arranged for automatic control on both the turbine drive and the motor drive. The turbine is kept hot at all times so that it will start operating automatically in the event of failure of the motor, magnetic coupling, or electrical system.

If, like The Ohio Oil Company, you want marathon performers in the mechanical draft field, by all means investigate the equipment we offer. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal



Why send a man to do a boy's work?

save money by matching the load . . . let silicones carry the overload!

You get a service factor ranging up to 50% with Dow Corning Silicone insulated (Class H) motors compared to 15% for Class A.

This built-in service factor saves you the initial cost of installing oversized motors to withstand the heat generated in reversing service, for example. In many applications, it saves the cost of over-motoring to carry intermittent overloads, or loads that can't be matched in standard frame sizes.

And eliminating the need for over-motoring gives you a better power factor and higher efficiency, because the smaller silicone insulated motors come closer to operating at full load most of the time.

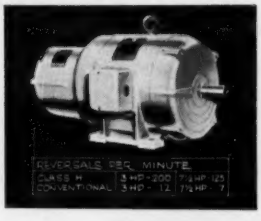
You also get more reliable service because motors insulated with Dow Corning silicones have superior resistance to heat, to a combination of heat and moisture, and to corrosive atmospheres.

Remember over-motoring is outmoded

to help you speed up production

LOUIS ALLIS

The Louis Allis Co. of Milwaukee has developed a line of rapid reversing motors which are silicone insulated and blower cooled to give a maximum number of reversals. A 3 hp Class H motor, for example, will do 200 idle reversals per minute compared to 12 for a conventional motor of the same frame size. A 7½ hp silicone insulated motor will do 125 idle reverals per minute compared to 7 for a conventional motor. These motors offer new production economies in any operation where high reversal capacity is required.



Dow Corning Corporation, Dept. 6902, Midland, Mich.

Please send me sources of supply for new Silicone (Class H) ☐ Motors ☐ Transformers

☐ Information on Louis Allis motors for rapid reversing service

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE _____ STATE _____

DOW CORNING SILICONES

DOW CORNING CORPORATION
MIDLAND, MICHIGAN

ATLANTA • CHICAGO • CLEVELAND • DALLAS • DETROIT
LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)

CANADA: Dow Corning Silicones Ltd., Toronto
GREAT BRITAIN: Midland Silicones Ltd., London
FRANCE: St. Gobain, Paris

Planning a new installation?

Here's news that may *save you money*

When you're planning a paper mill installation, one of the most critical decisions you'll have to make is the selection of pipe or tubing. Your decision, if not just right, can be an expensive one.

To give you a hand with this important chore, National Tube has established a tubing selection service. At your request, our specialists will evaluate your job specifications from every angle, taking into consideration pressures, temperatures, corrosives, etc., and will recommend the particular analysis that the installation conditions warrant . . . the material that will do the best job at the lowest cost to you. And this helping hand won't cost you a cent.

National Tube manufactures seamless pipe and tubes in a complete range of steel analyses from low carbon, through the alloys, up to and including stainless steels. A wide range of sizes and wall thicknesses are available for every mechanical and pressure purpose. Get in touch with us at your convenience.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
(Tubing Specialties)

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS NATIONAL Seamless Pipe and Tubes

WALLS WITHOUT WELDS

UNITED STATES STEEL

NEW TAYLOR BI-THERM* DIAL THERMOMETER

is so easy to read it invites frequent reading!

A SIMPLE, dependable and economical thermometer with many applications throughout the power industry. Wide variety of ranges from minus 40° to plus 750°F. 5" and 3" dials, stem lengths of 4, 6, 9, and 12 inches; separable wells of brass, steel, type 304 stainless steel or monel.

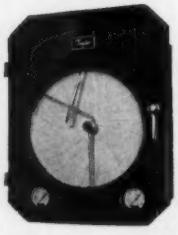
EASY TO READ: Black figures and graduations stand out.

RUGGED: All exposed metal parts are of arc welded, corrosion-resistant stainless steel. All instruments are waterproof.

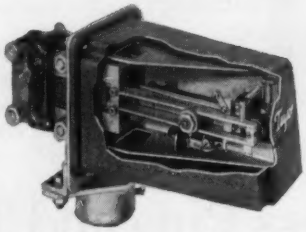
ACCURATE: The instrument is accurate within ±1% of range, over the entire range. Simple zero-setting features correct minor errors in readings which might result from severe mechanical shock. No ambient temperature effect. Overrange protection 50% up to 500°F.; 10% above 500°F.

VIBRATION DAMPED: Silicone damping in all instruments except 200° to 750°F. range results in increased speed of response, minimum pointer vibration, and elimination of pointer chatter.

ECONOMICAL: Costs only **$16 to $26,** depending on dial size and length of stem. Ask your Taylor Field Engineer, or write for **Bulletin 98267.** Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada.



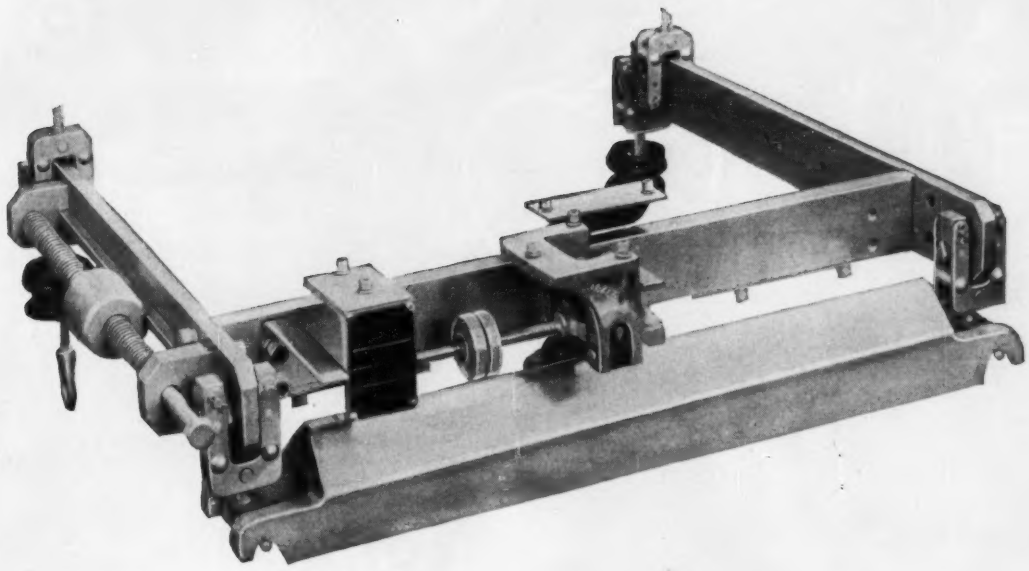
FULSCOPE* Recording Controller
For Desuperheaters, or for any close, accurate control of temperature, pressure, flow or liquid level. Quickly adapted to operating requirements.



TRANSAIRE* Differential Pressure Transmitter
A rugged, dependable and accurate instrument designed to measure flow, liquid level or specific gravity. A force-balance transmitter, it has a 1500 psi pressure rating and is available in two ranges; 20 to 200" and 80 to 800" of water.

*Trade Mark

Taylor Instruments
— MEAN —
ACCURACY FIRST
IN HOME AND INDUSTRY



Attention to Detail is the Reason Why

whatever you buy from Stock Equipment Company is of the highest quality. Take the weigh lever system illustrated above, for example. Top performance is assured because careful attention to design detail utilizes a non-welded steel assembly with steel loops. Hardened steel pivots and bearings in this light-weight unit mean low inertia and faster action with resultant greater accuracy.

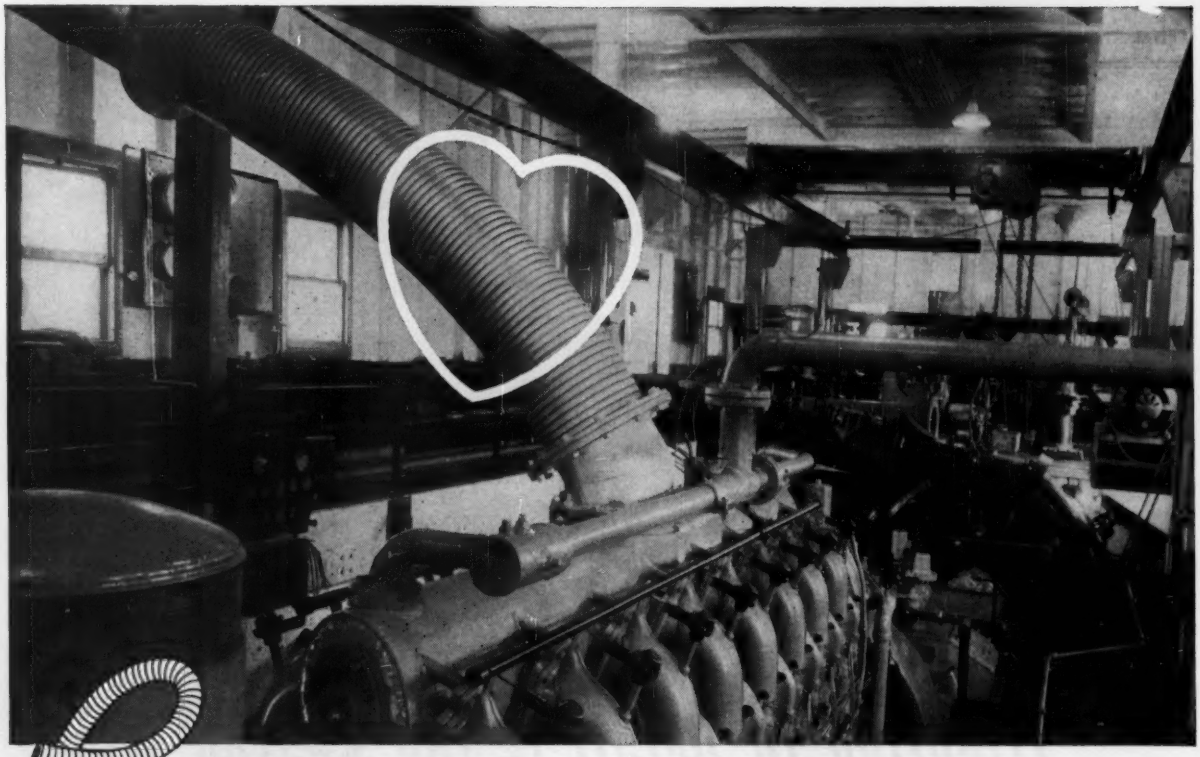
No matter if it's the design of a pivot in a weigh lever system, the layout of the overall job of delivering and weighing coal between bunker and pulverizer, or the fit of a dust-tight slip joint connection (as illustrated to the left), Stock Equipment Company takes time to make sure that it is right. This attention to detail means a completely satisfactory and overall economical job for its customers.

Dust-Tight Slip Joint Connections between CONICAL Distributor and stoker hopper with drive gate to shut off the flow of coal to any individual stoker hopper section.

Pride of workmanship is a common attribute of all S-E-Co. employees and is reflected in all items of their manufacture, which include the S-E-Co. Coal Valve, Soot or Sifting Valve, Automatic Coal Scale, CONICAL Non-Segregating Coal Distributor, Automatic-Under-Bunker Conveyor, and Paddle Type Coal Alarm. Next time you need such equipment, why not enjoy the advantages of having the best?

STOCK EQUIPMENT COMPANY
745-P HANNA BUILDING
CLEVELAND 15, OHIO

Specialists in Bunker to Pulverizer and Bunker to Stoker Equipment



Penflex CALMS DIESEL EXHAUST . . . ABSORBS VIBRATION . . . REDUCES NOISE

Flexible Tubing is Leak-proof, Rugged, Fatigue-free

When this big diesel starts the power she really purrs . . . No nerve shattering exhaust vibrations . . . overheated operating conditions . . . or shutdowns for broken pipes. The engineers solved these problems with one length of Penflex interlocked 14" tubing.

Penflex exhaust tubing is as tight as a pipe . . . but flexible. It flexes to soak up vibration. It dissipates the heat to prevent overheating. Its four-wall interlocked construction keeps gases tight as a pipe from exhaust port to stack.

Throughout industry on diesel installations—exhausts, air intakes, fuel, lubricating or water lines there's a Penflex tubing to increase operating efficiency. Penflex makes a complete line of four-wall, interlocking and seamless welded corrugated tubing, including braided wire or rubber covered types . . . ⅛" to 24" I.D. in materials suited to various conditions.

Let "Flexineering"—the science of selecting tubing of the right size, weight, type and construction for your particular installation—help you step up operating efficiency. Write for your copy of "Flexineering" today.

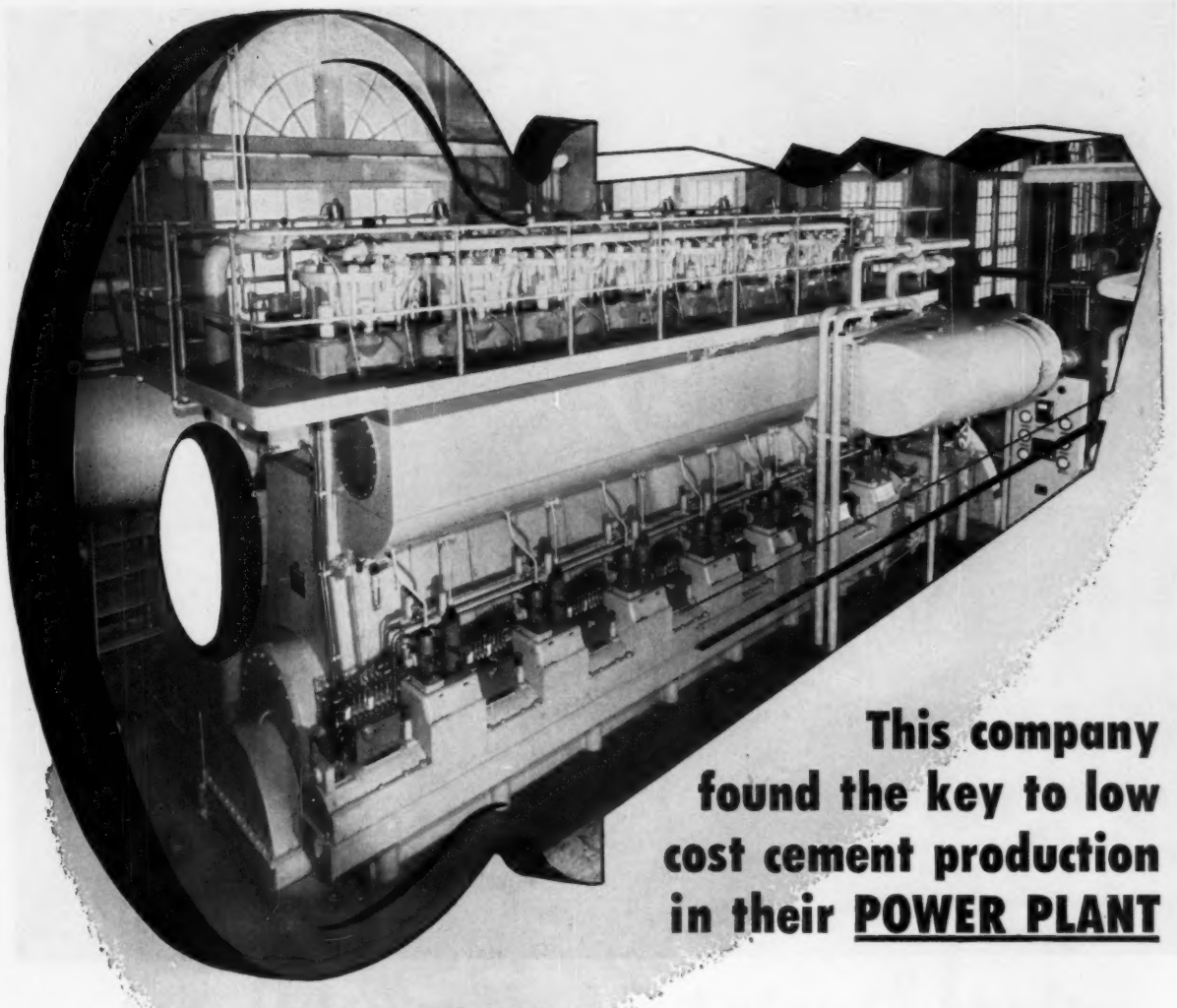
Pennsylvania Flexible Metallic Tubing Company, Inc., 4645 Powers Lane, Philadelphia 42, Penna. • *Branch Sales Offices:* Boston New York • Chicago • Houston • Cleveland and Distributors in Principal Cities

flexineering by

PENFLEX

HEART OF INDUSTRY'S LIFELINES

FLEXIBLE TUBING, AUTOMATIC BARREL FILLERS, PNEUMATIC RIVET PASSERS, ACCESSORIES AND FITTINGS



This company found the key to low cost cement production in their POWER PLANT

● Knowing that low cost power means lower cost cement production, this progressive company has long depended upon Diesel generating units as the main source of processing power for their modern cement plant.

The first Nordberg engine, a 3600 hp, 2500 kw gas burning unit, was installed in this plant in 1948. In 1953, when additional capacity was required, another large Nordberg gas burning engine was installed—a 3010 hp, 2100 kw unit.

It is interesting to note that while this plant has a total of eight Diesel generating units, the two Nordberg engines represent over half of the total installed horsepower and carry 75% of the total load.

This is another example of the way Nordberg Engines are used for dependable, low cost industrial power. Next time you have a chemical-process power problem think of Nordberg . . . builders of America's largest line of heavy duty engines, from 10 to over **12,000 horsepower.**

NORDBERG ENGINES FOR EVERY POWER NEED

For main or stand-by service, you can't beat the advantages of Nordberg Engines. They can be added to the line quickly, can be held ready for instant service without exorbitant stand-by expense, and are available for fully automatic operation. In the complete line of Nordberg two and four-cycle engines, including both oil and gas burning types, you will find exactly the right unit to meet your present and future power requirements . . . from 10 to over **12,000** horsepower.

NORDBERG

DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

NORDBERG MFG. CO.
Milwaukee, Wisconsin
Builder of America's Largest Line of Heavy Duty Engines

MAIL THIS COUPON TODAY

Nordberg Mfg. Co., Milwaukee, Wisconsin

Send information on Nordberg engines in the _____hp range for _____service.

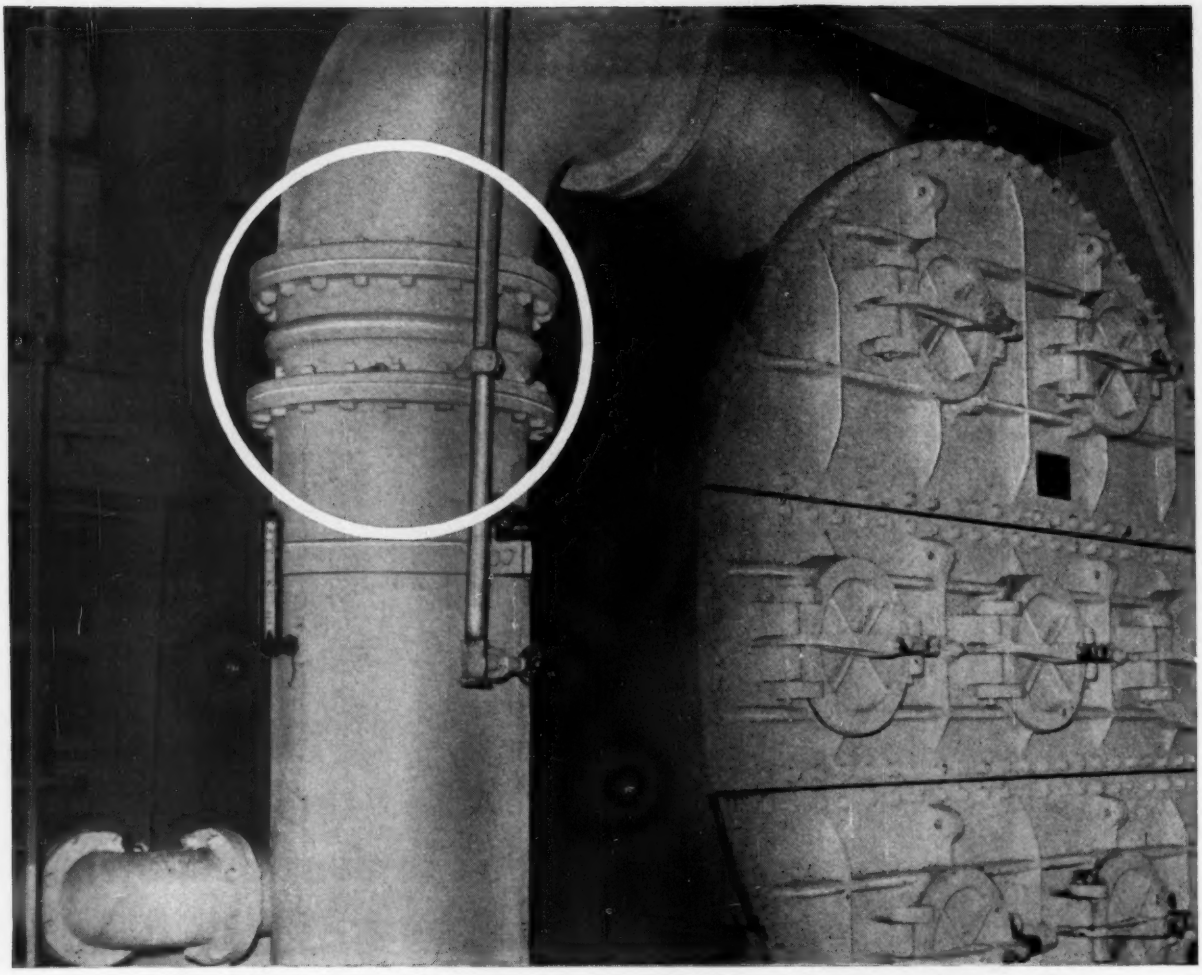
Name_____

Company_____

Address_____

City_____ Zone____ State_____

P1054



30-YEAR SERVICE RECORD CHALKED UP BY U. S. EXPANSION JOINTS IN WEST COAST POWER PLANT

Above is one of 12 U. S. Expansion Joints installed 30 years ago in a California utility plant. Despite their age these joints are still functioning.

U.S. Rubber Expansion Joints are economical, flexible connections used in pipe lines to take up the stresses due to vibration, expansion and contraction. They prevent the transmission of noise, and take care of misalignment. They have no moving parts to wear or bind and thereby shorten service life.

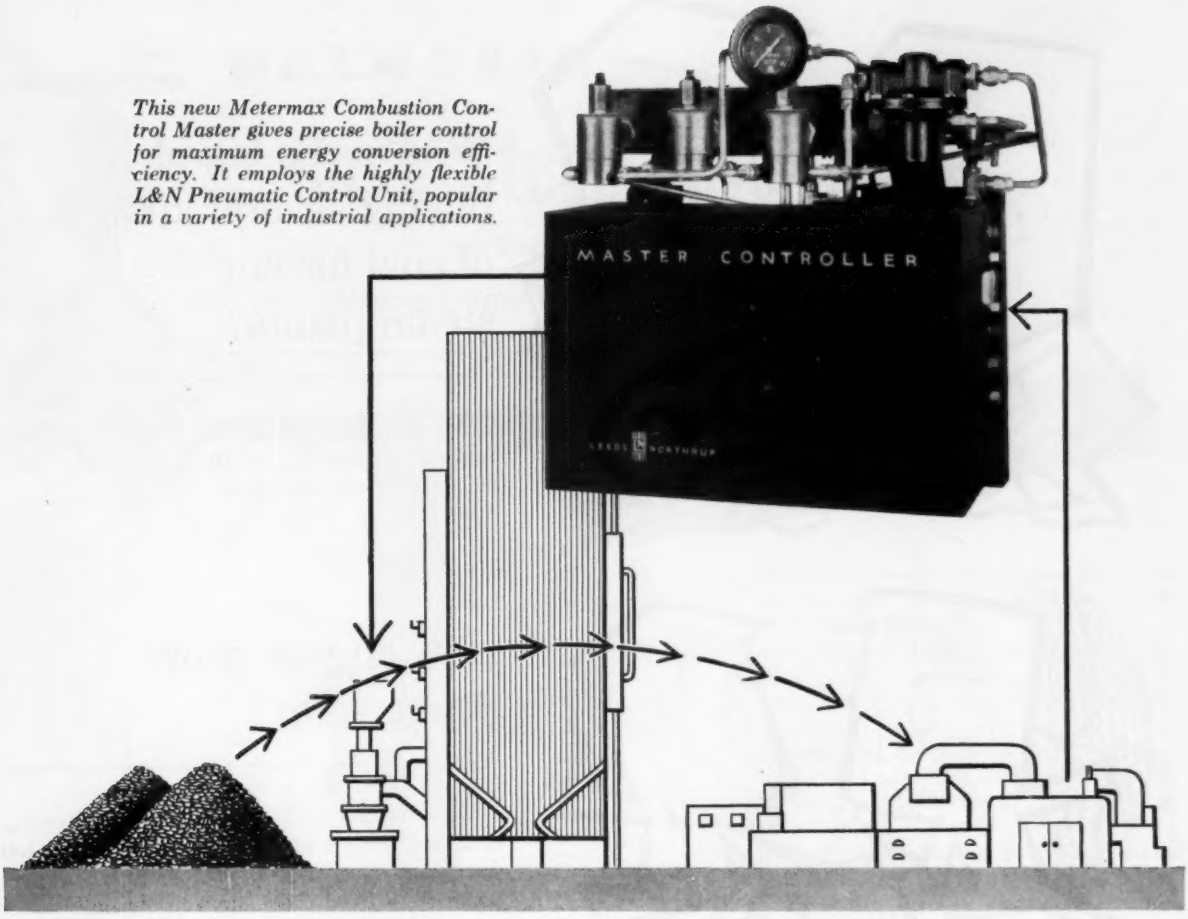
U.S. Rubber Expansion Joints can be installed on both new and old piping and equipment. These joints, plus engineering service, are available through any of our 27 "U. S." District Sales Offices, or write to us at Rockefeller Center, New York 20, N. Y.

US RUBBER

Mechanical Goods Division

United States Rubber

This new Metermax Combustion Control Master gives precise boiler control for maximum energy conversion efficiency. It employs the highly flexible L&N Pneumatic Control Unit, popular in a variety of industrial applications.



Let this "cost-conscious" brain

HELP SOLVE YOUR COMBUSTION CONTROL PROBLEMS

■ The widely-used Metermax Combustion Control now features this new Master Controller which gives you precise, stable boiler control over a wide load range. Because of its unitized design this Master coordinates the three fundamental control actions. Thus, you're assured of a precise blending of: *proportional action* to meet boiler load changes, *reset action* to maintain a constant steam pressure at all loads, and *rate action* to gear response to the speed and intensity of load swings.

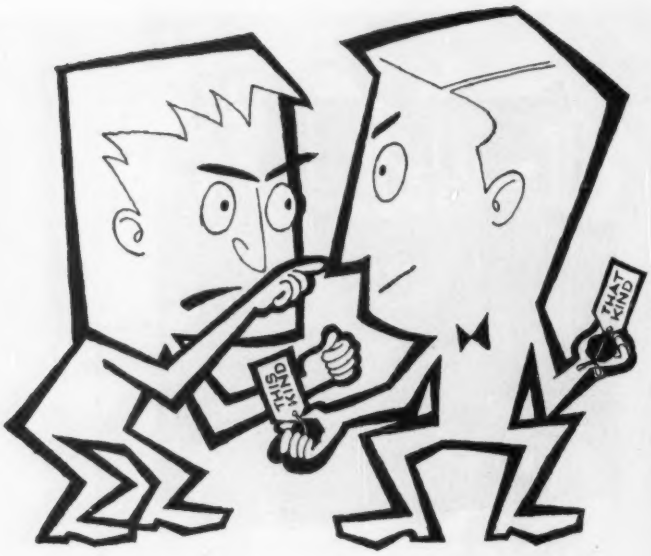
You get wide-range stability because the Master automatically "modulates" its own response as boiler load decreases to reduce control action at low loads for maximum stability. Your proportional, reset, and rate settings, once made to meet a given boiler load condition, are correct for all loads . . . automatically. You need not change or compromise your initial settings. These settings are easy to make, with an independent, calibrated dial for each action.

Boiler operators find this Master easy to work with. First, they can transfer to automatic quickly, because they can balance it to existing boiler conditions simply by turning a single, panel-mounted knob. The transfer is "bumpless," there's no boiler upset . . . no operator attention is needed after transfer. Second, operators get instant action from the Master because there are no long control tubing runs. Control circuits are electric all the way from the control room to the "control center" where the Master and the individual Metermax Controllers are located. This, plus electric transmission to the electric drive units, provides instant response. And third, the Master adjusts itself as load decreases, for low-load stability, thus relieving the operators of this additional duty.

Precise control . . . wide-range stability . . . fast response . . . ease of operation. That sums up what you can expect of Metermax Combustion Control.

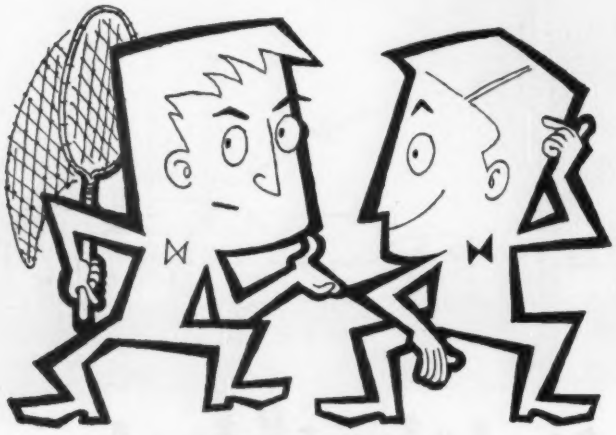
For more information on this Metermax Master, write to Leeds & Northrup Company, 4910 Stenton Ave., Philadelphia 44, Pa.

LEEDS [L N] **NORTHRUP**
instruments *automatic controls* • *furnaces*



What's the big idea buying several kinds of coal for our steam plants?

It's a good idea. The kind of coal that burns most economically in the old boilers isn't efficient for the new ones.



How do you know you're right?

Look at the coal bills. We are generating more steam at a lower fuel cost. You can tell from the ashes we are getting more complete combustion, and there's less clinkering.

Where did you get this idea, anyway?

From the C & O Coal Department. They convinced us that different types of burning equipment need different types of coal. From the high quality coal produced on the C & O, we selected the quality and size of coal that works best in our particular installations.

P.S.

There's a lot more to buying coal than the cost per million BTU. Why not contact coal producers on the C & O to solve your particular fuel requirements, or write to: R. C. Riedinger, General Coal Traffic Manager, Chesapeake & Ohio Railway Co., Terminal Tower, Cleveland 1, Ohio, for the assistance of a C & O fuel service engineer.

Chesapeake and Ohio Railway

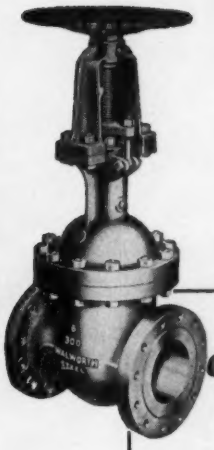
WORLD'S LARGEST CARRIER OF BITUMINOUS COAL

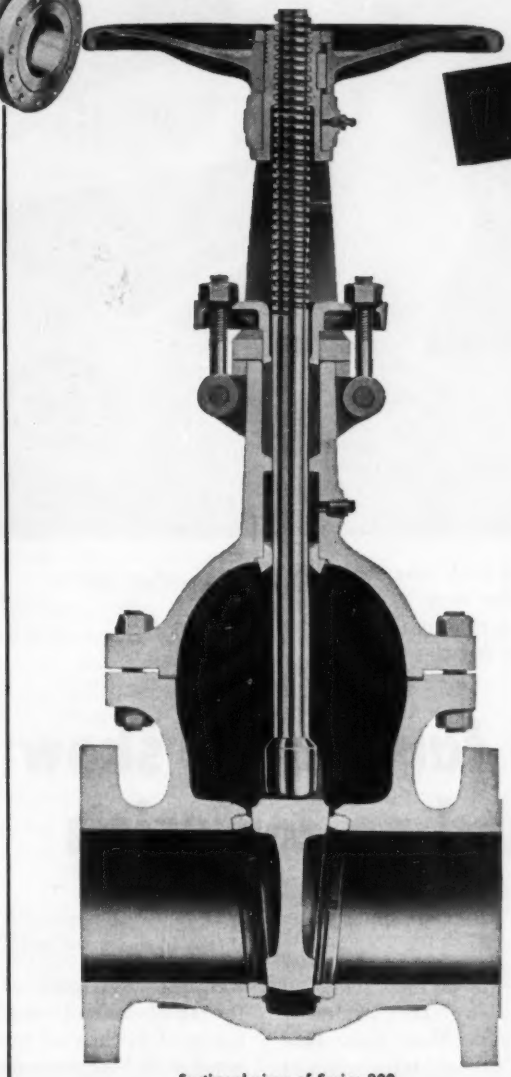
WALWORTH

Cast Steel Gate Valves

Series 150 and 300

Wedge Gate — Outside Screw and Yoke





Sectional view of Series 300

Big 8-Point Superiority!

Gland clearances are such that stem cannot be scored if gland should be tightened unevenly.

Deep Stuffing Boxes in all sizes (2″ to 24″) insure tightness and maximum packing life — costly leaks are eliminated.

Bonnets and Bodies are engineered to withstand pressure and minimize distortion — they're tough, durable, dependable.

Heavy Steel Walls provide extra strength and longer life.

Integral Body Guide Rib Faces are machined to insure accurate disc seating.

Seat Rings are bottom seated — not flange type. No recess exists at back of ring — hence no turbulence, erosion, or pressure drop.

Streamlined Ports allow high velocity, non-turbulent flow, and reduce the possibility of erosion.

Valves regularly have flanged ends. They can be supplied with ends for butt welding. Roller bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

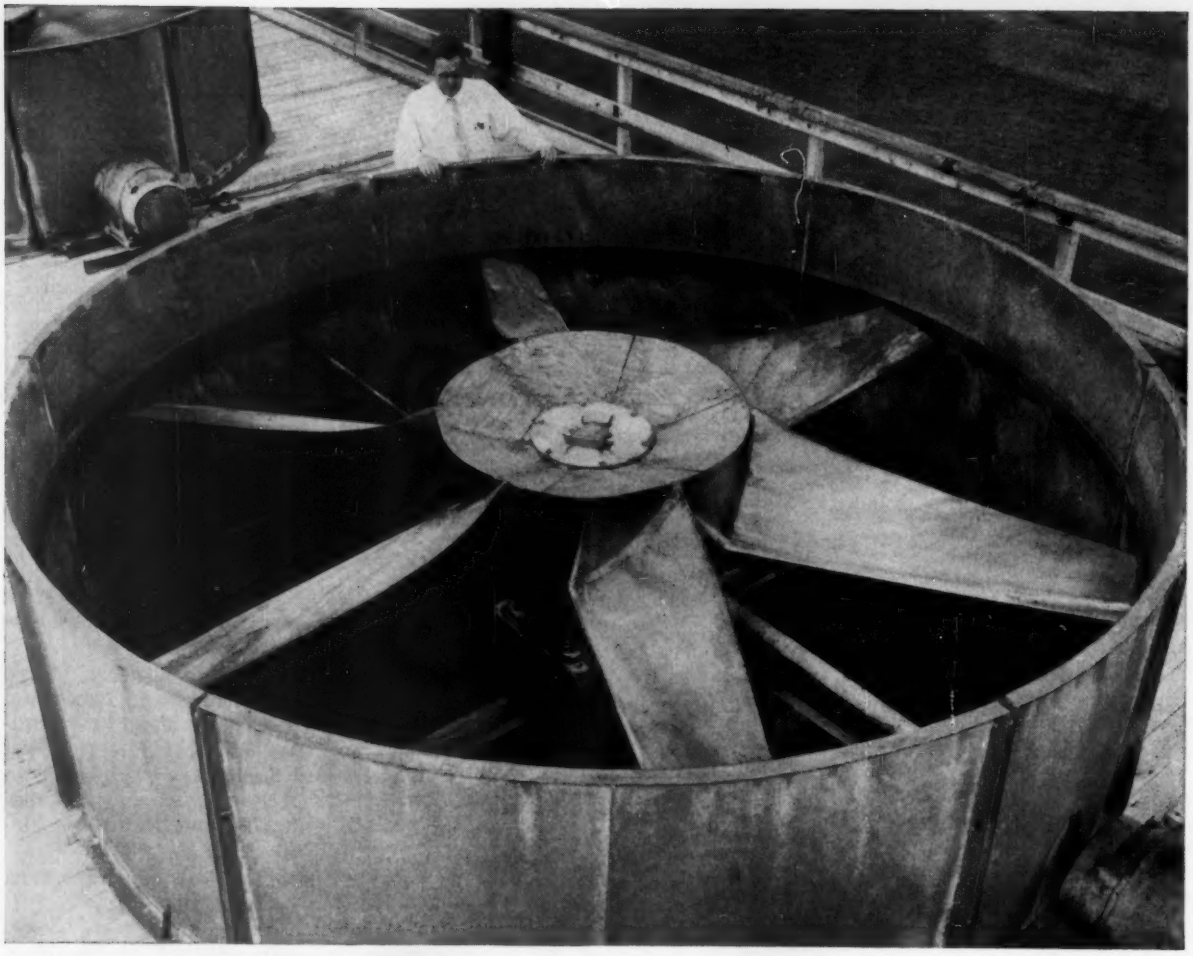
For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.

For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.



Inspecting Monel blades of 14-foot fan. *Sixteen such fans cool recirculated water for the 32,000 sq. ft. condenser in a 48,000 KW unit of Clark Station (Houston) at a rate of 37,500 G.P.M. After 850-million round trips through alkaline fog these . . .*

tireless Monel fan blades show no erosion and no corrosion

Cooling water for a unit of Houston Lighting & Power Co.'s Clarke Station is drawn from wells . . . recirculated through a condenser.

This water, must, itself be air cooled in a cooling tower. Sixteen, 14-foot diameter Class 7000 Moore fans suck the air through. With it ride millions of droplets of hot alkaline water.

Impact and corrosion from these tiny droplets attack the fan blades. What's more, the blades must absorb enormous numbers of slight flexures . . . and physical shocks caused by turbulence. Not many materials could take it.

But Monel* nickel-copper alloy does.

Look at the Monel alloy blades on the fan shown above! They've already lasted eight years. Made more than 850-million "round" trips without noticeable defect. So have the Monel blades on the other fifteen fans. And they seem to have years of service left.

The Moore Co., Marceline, Mo., says, "In cooling tower fan blades, Monel performs well consistently. And we find it easy to shape and weld."

Maybe you should be using Monel for fan blades and other parts calling for good mechanical properties combined with high corrosion resistance. To look into it, simply contact Inco's Technical Service...an advisory group.

*Reg. Trademark of The International Nickel Company, Inc.

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

INCO Nickel Alloys

Monel...*for minimum maintenance*

Thomas A. Edison Inc.'s

PERSONAL DEMONSTRATION

shows how you can

INCREASE PLANT PRODUCTION

Our representatives throughout the nation are ready to demonstrate *a complete* Omniguard system right at your plant or office.

Takes Only a Few Minutes to Prove Simple Omniguard System Protects Bearings and Processes; Cuts Down Time; Increases Equipment Life

Just take a few minutes to prove to yourself how Omniguard can make it possible for you to operate your equipment at peak production rates without fear of breakdowns . . . how this simple temperature detection system gives you ample opportunity to prevent bearing failures or to keep process temperatures within limits.

RECORDS REVEAL FAILURES COSTLY

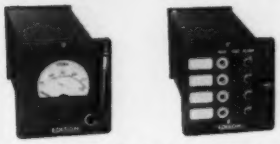
Many operators—after a record check—are astonished to find how much bearing breakdowns have been costing them in maintenance and lost production. They see that the cost is often many times the expense of installing Omniguard.

COMPLETE 4-POINT SYSTEM FOR LESS THAN $500

Consider the thousands of dollars involved in equipment and production output. Contrast this with the fact that one Omniguard unit costs less than $500. And because of its simplicity, installation costs are also low.

SIMPLE, DEPENDABLE

Omniguard has no electronic or moving parts. It is the most dependable system available today. Modular in design, each unit gives you four-point detection. You can add as many as you need . . . as you need them.



The modular indicator and monitor, with their mounting brackets, and the resistance temperature detectors, are all you need for a continuous operating analysis of remote process or bearing temperatures.

Resistance Temperature Detectors

These are just four of the many different types of temperature detectors produced for varied applications of the Omniguard system.

The 242P for high temperatures (to 1300°F.)

The 166NC with pre-loaded sensitive tip specially designed for bearing protection.

The 230N for general purpose industrial use (stem-sensitive).

The 235N90-35 for fast response in corrosive service.

A Partial List of Present Users

American Blower Corp.
City of Chicago
Combustion Engineering, Inc.
DeLaval Steam Turbine Co.
Eastman Kodak Co.
Esso Standard Oil Co.
Florida Power & Light Co.
General Electric Co.
Hercules Chemical Co., Inc.
I-T-E Circuit Breaker Co.
North American Aviation, Inc.
Public Service Electric & Gas Co.
Republic Steel Corporation
Sun Oil Company
Union Carbide & Carbon Corp.
Westinghouse Corp.

Thomas A Edison

A GREAT NAME CONTINUES GREAT NEW ACHIEVEMENTS

Thomas A. Edison

INCORPORATED

INSTRUMENT DIVISION • 41 LAKESIDE AVENUE • WEST ORANGE, NEW JERSEY

To get your free demonstration, just fill out the coupon below.

Please have representative call for appointment at no obligation to me_____

Please send detailed information_____

Name_____

Firm_____

Address_____

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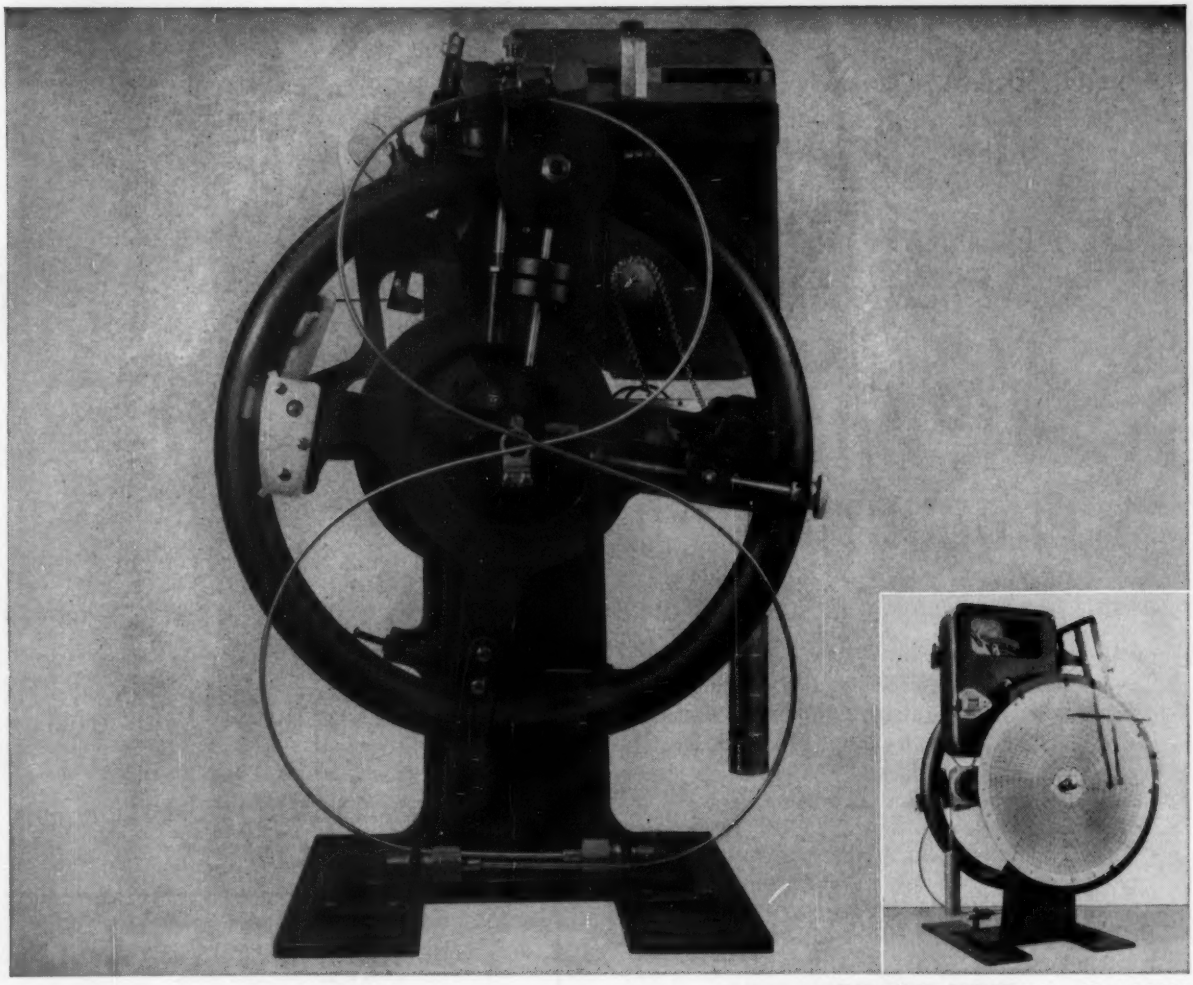
Position_____



Recording and integrating Model 2656
(case removed)

Simple, direct action makes

HAGAN RING BALANCE METERS

tops in Accuracy and Dependability

Simple, direct action and sturdy construction assure dependable, trouble-free service in Hagan Ring Balance Meters. The famous Ring Balance principle produces high accuracy, even at low differentials and at low rates of flow.

Hagan Ring Balance Meters are available for any gas or liquid flow measurement. Check these many outstanding features and see how they can help you get accurate and dependable metering with really low maintenance.

- **Calibration of meter may be checked with dead weights in a few minutes, without disconnecting the meter from the line.**
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Why Arizona Public Service chose Triple-Zone Gilsulate to protect 1200-foot fuel and steam lines

Sought lifetime protection against heat loss and corrosion

For its new Saguaro steam electric station near Red Rock, Arizona, the Arizona Public Service Company investigated several types of hot underground pipe insulation. The pipe system consists of three seamless carbon steel hot fuel and steam lines, totalling 1,200 feet, with welded joints running side by side between a 55,000-bbl. fuel oil storage tank and two 950,000 pound/hour steam generators.

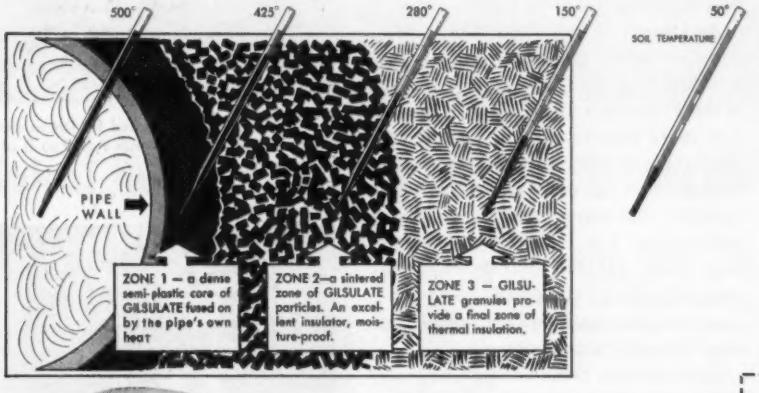
Arizona Public Service Company found that GILSULATE gave the quickest, simplest and most economical system of insulation for its underground hot fuel and steam lines. Approximately 40 tons of GILSULATE were poured and tamped by 10 laborers in two 8-hour shifts – far less time and less expense than required for the other types of insulation investigated.

This is the experience of hundreds of other installations – *Triple-Zone GILSULATE shows the lowest cost per installed linear foot of any hot underground pipe insulation!*

Facts about Gilsulate

1. *Easy to use*—just pour, tamp and backfill…pipe heat does the rest.
2. *Forms 3 zones of protection* against heat loss and all commonly encountered hazards to hot buried pipes.
3. *Needs no sleeves* or mechanical sheaths: no mixing or special handling.
4. *Needs only* normal pipe spacing: for multiple pipe or cramped conditions.
5. *3 types* for varying temperature ranges up to 520° F.

Lines include five horizontal expansion U-bends. A 6-in. fuel oil supply line, a 4-in. fuel oil return, and a 4-in. saturated steam line leading to the fuel oil tank heater were placed side by side in a 37-in. wide trench, and covered with GILSULATE. After light tamping of GILSULATE, trench was backfilled—and the work was done.


500°
425°
280°
150°
50°
SOIL TEMPERATURE
PIPE WALL
ZONE 1 – a dense semi-plastic core of GILSULATE fused on by the pipe's own heat
ZONE 2—a sintered zone of GILSULATE particles. An excellent insulator, moisture-proof.
ZONE 3 – GILSULATE granules provide a final zone of thermal insulation.

THE TRIPLE-ZONE INSULATION FOR LIFETIME PROTECTION OF HOT UNDERGROUND PIPES

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P

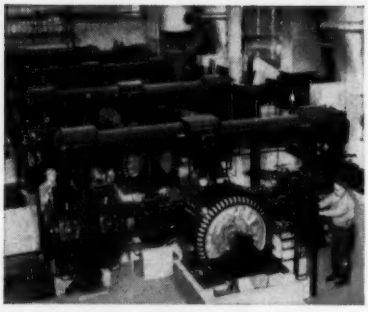
How Ford beat the construction *squeeze* at Mahwah

Steam and air flow from this boiler compressor building to meet production demands of Ford Motor Company's largest automobile assembly plant at Mahwah, N.J. Completed in 13 months, a safe margin ahead of the main assembly plant, it is a good example of how Dravo's "complete package" construction service can work for you.

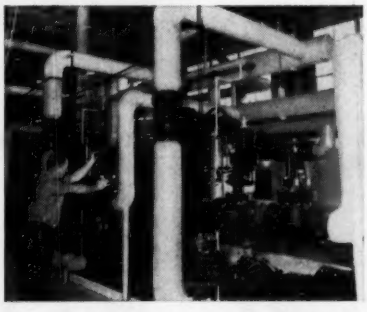
When Ford engineers planned the construction of their mammoth new automobile assembly facility, they decided to minimize delay in putting the multi-million dollar plant in production by taking full advantage of outside construction services. Dravo's power plant construction specialists were called upon to handle the construction-engineering and construction of the boiler-compressor house. Working as a team, Ford specified the steam and air needed and left the construction planning and erection of the facility up to Dravo.

As a result of this teamwork, all material and equipment was on order within a month, field construction work started in three months and initial boiler operation in 13 months. But in addition to this saving in time, costs were also cut through the use of basementless construction and many other construction innovations. The complete plant contains three 132,000 lb/hr boilers and four 2400 cfm air compressors—all conveniently arranged on one operating level with centralized control.

You, too, can profit through Dravo's single-contract responsibility, ranging over all types of jobs from power plant erection to the installation of a pump. Write for Bulletin No. 1300.



Four air compressors installed by Dravo supply the Ford assembly plant with 9,600 cu ft of air per minute.

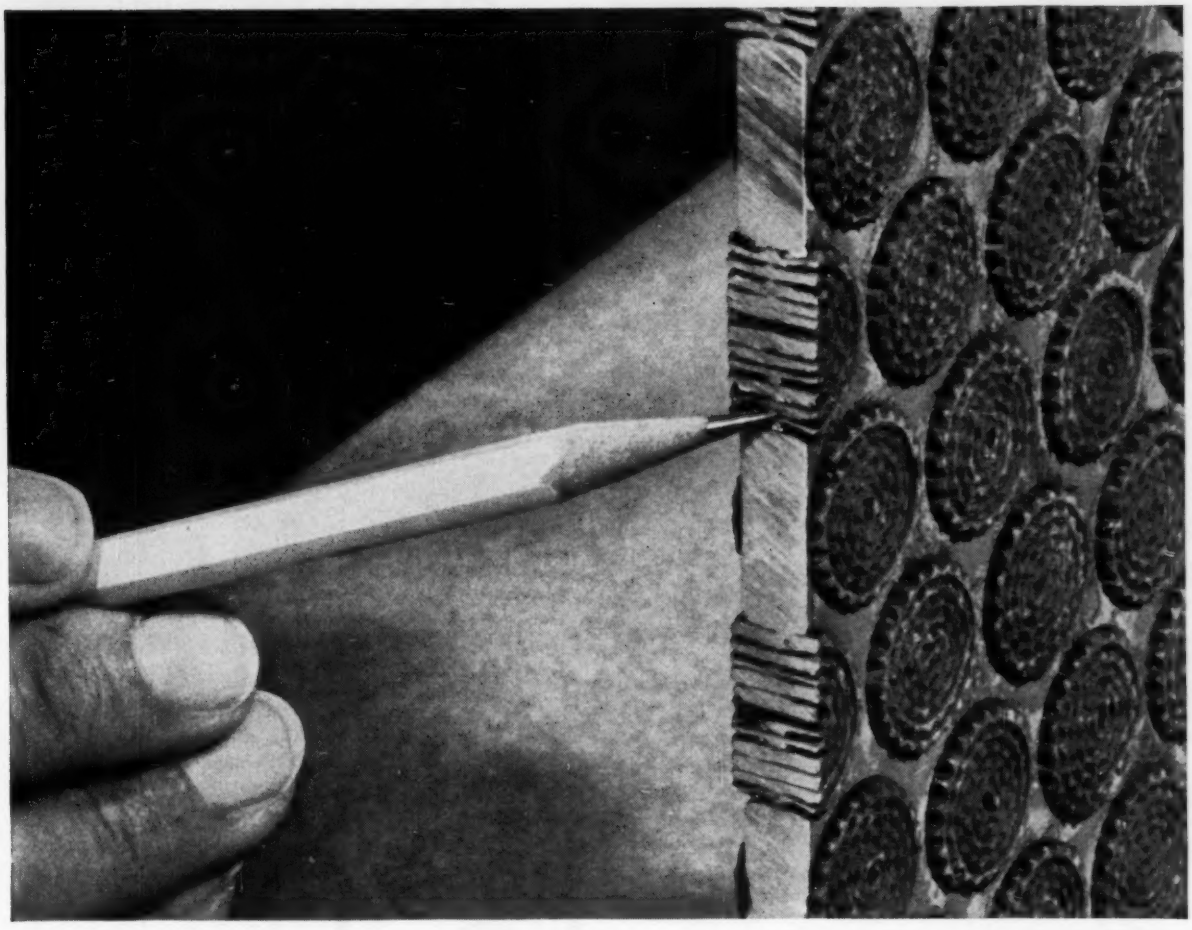


Power piping for the boilers at Ford's Mahwah assembly plant was fabricated at Dravo's Marietta, Ohio, plant for erection on the site.

DRAVO
CORPORATION
Fifth and Liberty Avenues, Pittsburgh 22, Pa.

EXIDE-MANCHEX BATTERIES

Emergency power source for generating and substations



Spiral buttons act like shelves for oxide—prolong battery life

SWITCHGEAR BATTERY. Exide-Manchex Batteries are available in a wide range of capacities from 40 to 960 ampere hours, with improved high rate discharge characteristics. Compact construction saves space and weight. Flat cover easy to clean. Write for Bulletin No. 4852.

In ordinary batteries, the active material clings to the vertical surfaces of the positive plate—forever fighting the forces of gravity and turbulence. Let it loosen its grip and down it comes. And there goes battery life.

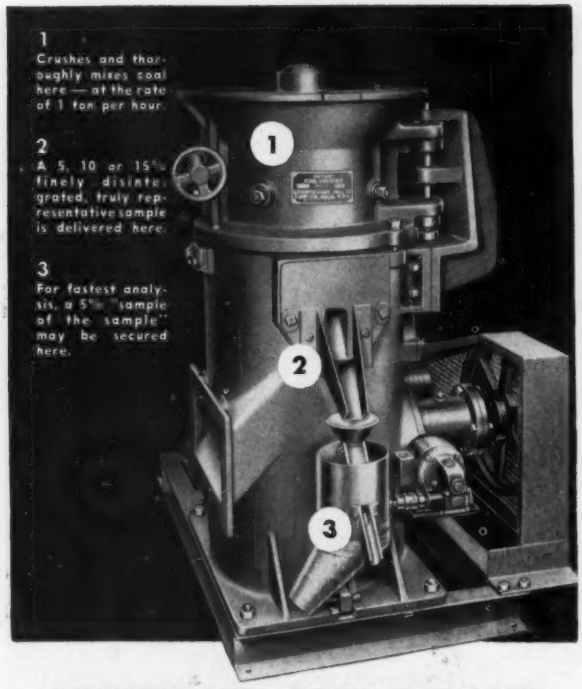
Not so with Exide-Manchex Batteries. Active material is built up between the spiral layers of these unique lead buttons that act like tiny shelves. There it rests, supported against gravity and electrolyte turbulence. And there it stays for years and years and years.

This simple design principle is one of the several tangible reasons for the long, useful life of Exide-Manchex Batteries. Used in a wide variety of floating service applications, these batteries have earned a reputation for long, dependable service unsurpassed in the entire world. And this method of construction is available only in Exide-Manchex Batteries.

When you order batteries for applications where you need dependable performance and long, useful life, or when you buy equipment using this kind of battery, be sure to specify Exide-Manchex Batteries. Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 2, Pennsylvania.

Exide®

Samples Coal Shipments in a Matter of Minutes!


1
Crushes and thoroughly mixes coal here — at the rate of 1 ton per hour.
2
A 5, 10 or 15% finely disintegrated, truly representative sample is delivered here.
3
For fastest analysis, a 5% "sample of the sample" may be secured here.
1
2
3

STURTEVANT COAL SAMPLER
with New Automatic Splitter

It's a fact! Big users of coal and coke know the true B.T.U. value of deliveries before moisture has a chance to evaporate . . . thanks to the speedy crushing, homogenizing and proportioning actions of the Sturtevant Automatic Coal Sampler and its Automatic Splitter. So, they get what they pay for . . . and increase boiler efficiency in the bargain.

Handles a ton an hour! The Sturtevant Automatic Coal Sampler takes 3" or smaller coal or coke and crushes it to 6 mesh or finer. Sample spout takes off 5, 10 or 15% of the finely crushed homogenous mixture, as desired. Then, the optional Automatic Splitter takes a 5% "sample of the sample."

"OPEN-DOOR" DESIGN
provides "One Man, One Minute" accessibility for all cleaning and maintenance — an exclusive Sturtevant feature that saves valuable down-time.

Want more information? *Write for all the facts about the Sturtevant Automatic Coal Sampler — the tested shortcut to accurate B.T.U. analysis.*

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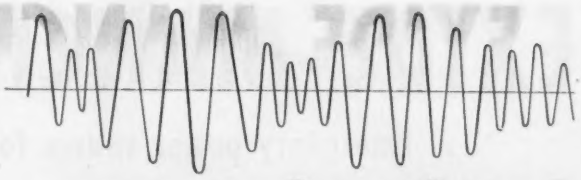
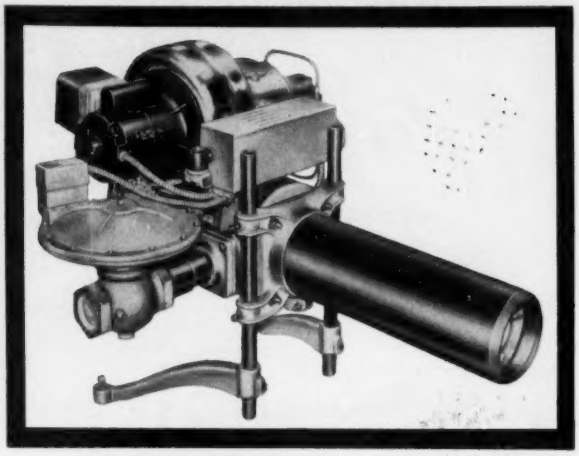
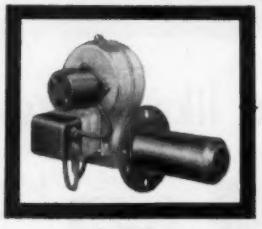


no pulsation!

the Syncro-Flame Dual-Fuel and Power Gas Burners will fire without PULSATION all types of boilers, warm air heating units and SCOTCH MARINE BOILERS



the burner head design of Syncro-Flame Dual-Fuel and power gas burners permit firing at rated inputs without pulsation. Syncro-Flame's Dual-Fuel burns either gas or oil at maximum efficiency—fuel/air changeover is automatic—operating by either outside thermostat or remote manual control. Syncro-Flame's Dual-Fuel unit is the most reliable of all. . . . Approved over the entire range of operation by Underwriters Labs. Write for spec. sheets and verified facts on savings your processing customers can make by using dual-fuel—burning gas in the off-peak season, or when the load is low.



syncro-flame power gas . . .

these burners operate at maximum efficiency . . . using the same high efficiency head with forced mixing of fuel and air . . . a short, swirling flame works where you need it . . . not on the furnace wall.

You're money ahead buying an approved and field proven unit. Syncro-Flame burners have been in constant use since 1951. 75,000 to 4,100,000 BTUs/hr. capacities.

syncro GAS flame BURNER
syncro DUAL GAS-OIL flame BURNER

synchronous flame inc.
200 n. main st., walworth, wisconsin

Return line corrosion resulting from carbonic acid

ALL pHOULED UP

pH—a symbol denoting the negative logarithm of the concentration of the hydrogen ion in gram atoms per liter. This scale permits the expression of both acidity and alkalinity in units which can be measured by means of a hydrogen electrode.

That's what chemists say about it. Some of the things that power plant engineers say about it are best left unquoted.

A low pH value in condensate can cause a power plant engineer a lot of trouble. When the pH value of water goes below 6.9, it's becoming acid—and when it's acid, it's highly corrosive. Then it begins to eat away at the internal surfaces of pipes and return lines.

Corrosion caused by low pH is most effectively prevented by the application of Dearborn's FILMEEN.* By forming a non-wettable, monomolecular coating on all metal surfaces with which treated steam or condensate come in contact, FILMEEN provides a protective, corrosion-inhibiting barrier between water and metal. By preventing the carbonic acid from touching the metal surfaces, FILMEEN thus keeps the lines corrosion-free.

When you find rusty condensate coming back to your boilers, it's time to see your Dearborn representative. He'll show you how FILMEEN will reduce excessive maintenance, avoid shutdowns and protect valuable equipment in your power plant.

**FILMEEN—U. S. Pat. No. RE-23614 reserves to Dearborn Chemical Company and its licensees exclusive right to the use of octadecylamine for water treatment.*

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☐ Send a copy of Bulletin 5013-B on FILMEEN.
☐ Have a Dearborn representative call.

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so Halstead & Mitchell engineers said . . .

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Nothing has more of a bearing on cooling tower performance and life than do tower fan bearings. On them turn *the only moving parts* in an induced draft cooling tower.

Announcement by Halstead & Mitchell engineers of a *permanently* sealed and lubricated fan bearing means a lifetime of continued high cooling tower efficiency. The complete elimination of periodic greasing means a drastic reduction in your tower maintenance costs.

With not one bearing failure reported from hundreds of towers now in use, this advance gives you, more than ever, the best buy in cooling towers on the market today.

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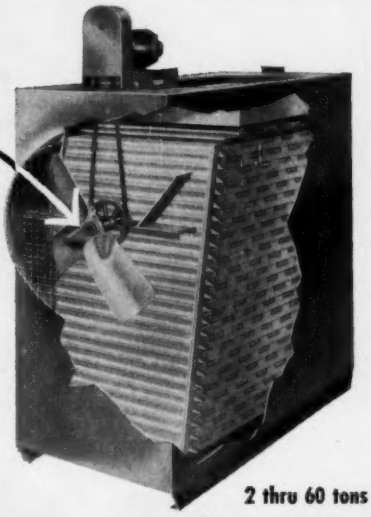

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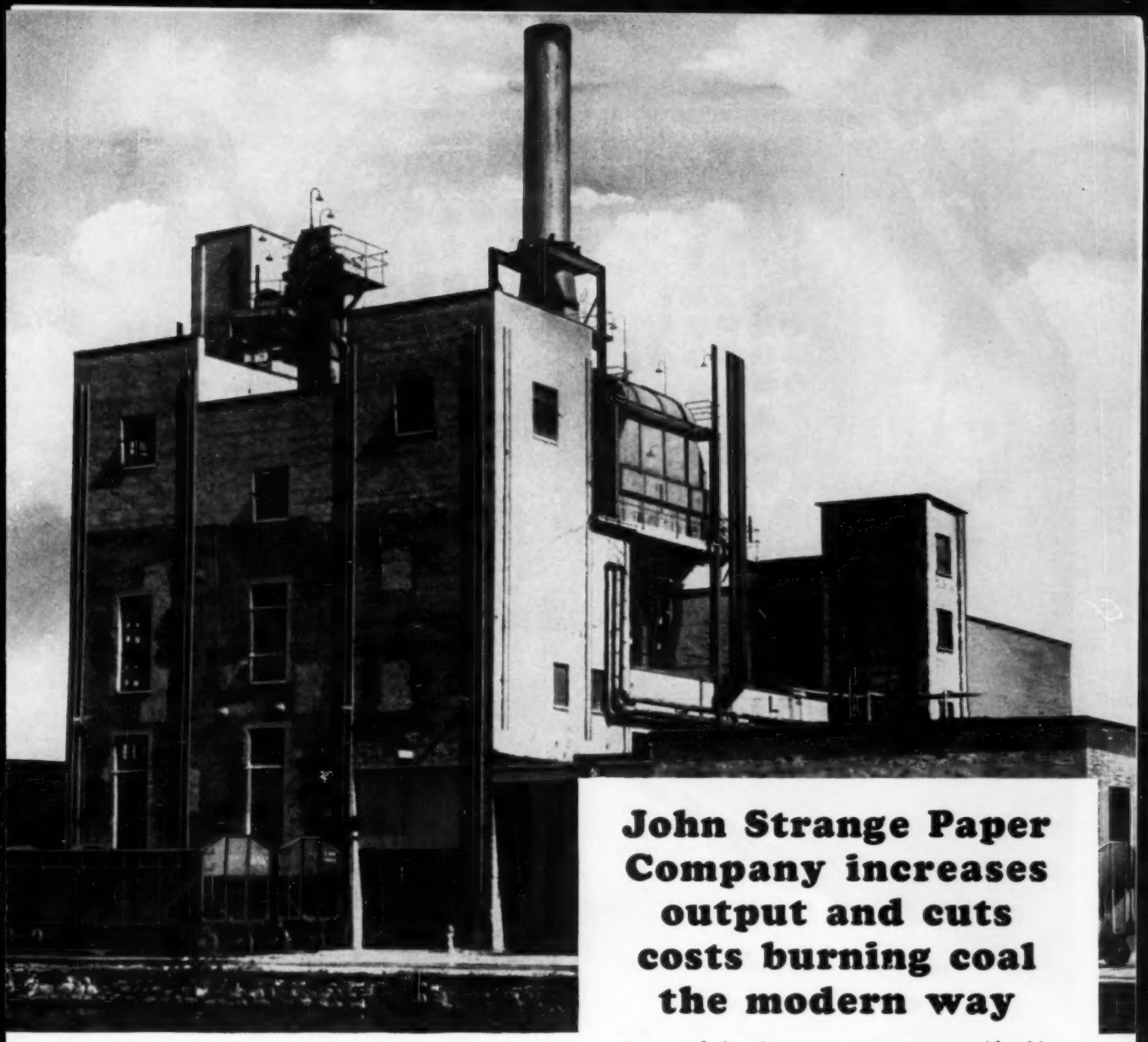


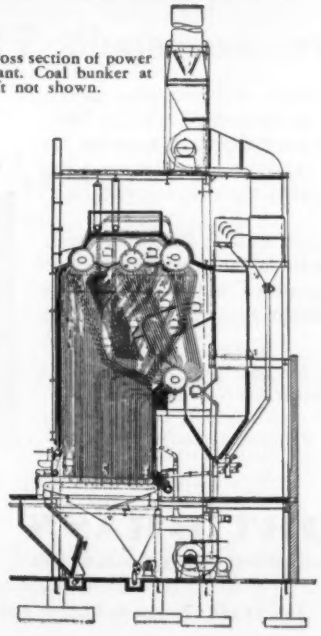
John Strange Paper Company increases output and cuts costs burning coal the modern way

Steam and electric power represents a considerable percentage of overall costs in paper mill production. In addition to this cost problem, the power plant of the John Strange Paper Co., Menasha, Wis., lacked sufficient capacity to meet the mill's demand for steam and power.

In an effort to trim costs and increase capacity, the company called in the consulting firm of Cummins & Barnard, Inc., Ann Arbor, Mich., to recommend a modernization program. Based on those recommendations, today John Strange burns coal in highly efficient steam-generating equipment. The remodeled installation includes completely modern coal-handling and pneumatic ash-handling equipment as well as two automatic control systems. Costs have been curtailed; steam and power supply is dependable. Most important, the mill machinery operates at higher speed, resulting in a 10% increase in production.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

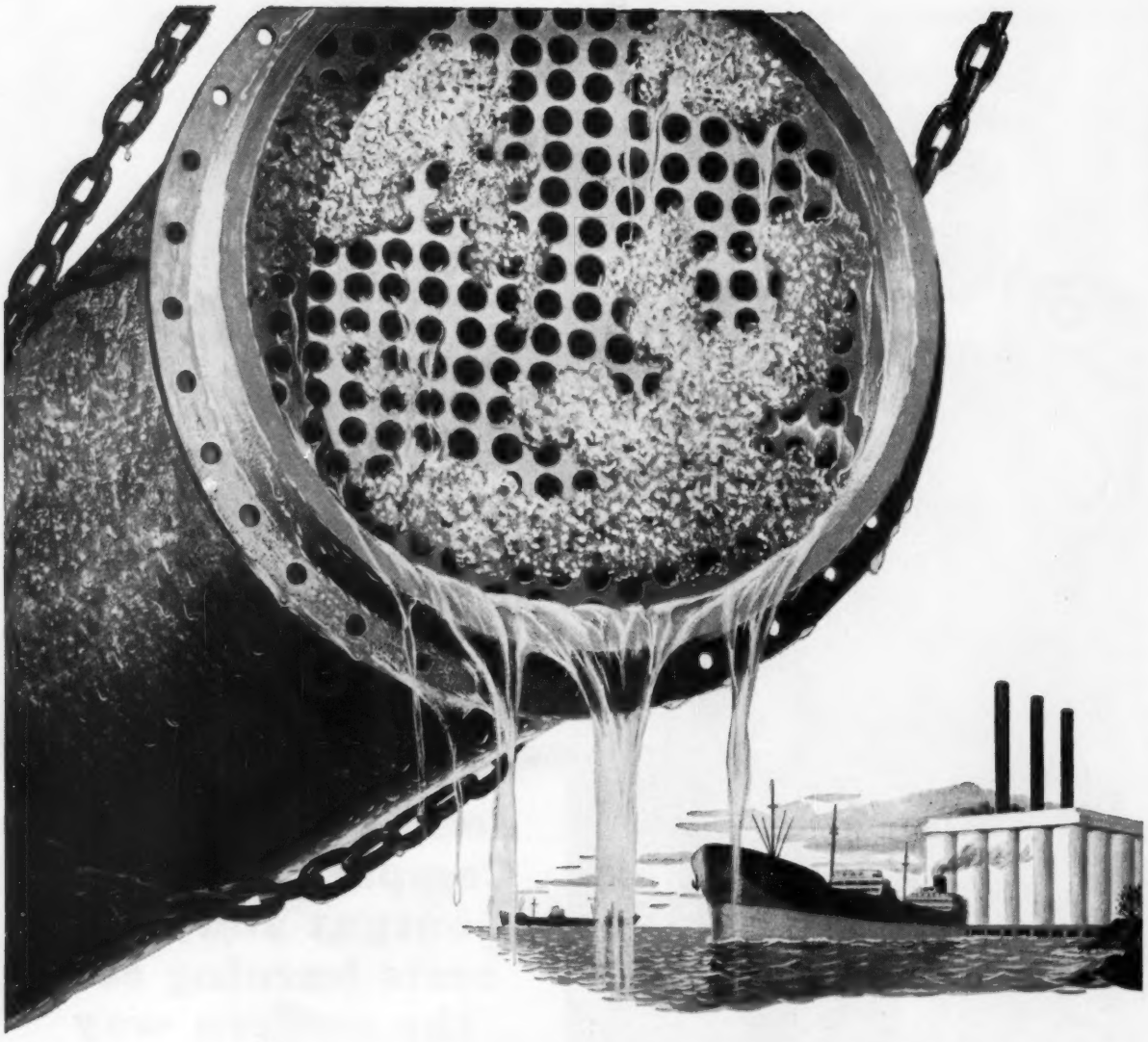
NATIONAL COAL ASSOCIATION
Southern Building, Washington 5, D. C.



Cross section of power plant. Coal bunker at left not shown.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum • Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.



Here's where *balanus improvisus* spells TROUBLE

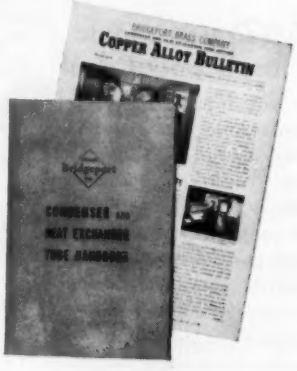
Spawning crustaceans such as barnacles (balanus improvisus) can greatly accelerate corrosion in condenser tubes. Slime, contaminated water, high water velocities — these, too, can contribute to corrosion and reduce tube life.

That's why it's important to remember Bridgeport whenever you think of condenser tubes. Tube alloys vary appreciably in their resistance to corrosion, making it essential to select the proper alloy for each operating condition. And that's where Bridgeport can help you.

Through 45 years of research and condenser tube manufacturing, Bridgeport has developed a wide variety of condenser tube alloys, one of which will meet your service requirements. Bridgeport's Technical Service and Corrosion Laboratory have the experience and facilities to recommend the most effective alloy for any corrosion-causing condition.

A call to your nearest Bridgeport sales office can be valuable to you. They'll show you how Bridgeport Condenser Tubes can increase condenser life and cut operating costs.

Write today for your copy of Bridgeport's 162-page Condenser and Heat Exchanger Tube Handbook. Are you receiving the Bridgeport Copper Alloy Bulletin regularly? If not, ask for it too.



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After the Great Ford Foundation Gift . . .

What Still Remains To Be Done To Provide Decent Faculty Pay

The Ford Foundation's gift of a half billion dollars to our privately supported colleges, medical schools and hospitals, now being distributed, is magnificent. But it will be much more magnificent if it inspires completion of the job to which it gives a lift. So far as the colleges and universities are concerned, this job is primarily to rescue their faculty members from being second-class citizens economically.

Even in a period when we have become accustomed to astronomical financial figures, a half billion dollars remains an eye-popping gift. In fact, it is so imposing that a good many people who don't read the fine print are apt to conclude that it must just about solve the financial problem to which it is addressed.

Goes Only a Small Way

However, we have allowed college professors to fall so far behind the parade financially that the share of the Ford half billion dollar gift going directly to the improvement of faculty salaries ($210 million) will go only a small way financially toward doing what is necessary to provide adequate salaries.

Completion of this job for our privately supported colleges and universities calls for:

1. An increase in faculty salaries at least five times as great as that made possible by the Ford gift merely to restore salaries to their 1939 purchasing power level and an increase fifteen times as great to provide adequate salaries today.

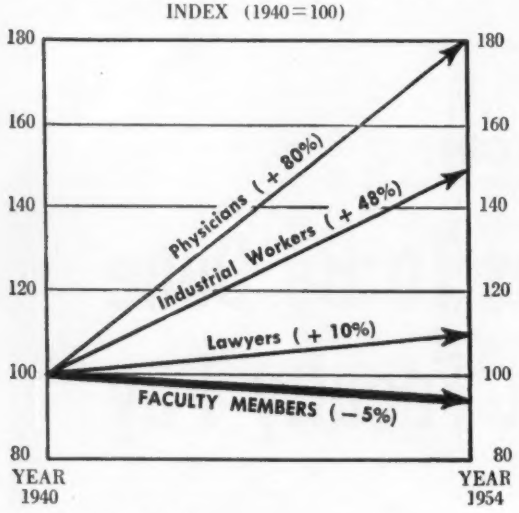
2. Some difficult and courageous decisions by the heads of the colleges and universities in apportioning the grants received by them.

Terms of Gifts to Colleges

The $210 million of the Ford Foundation gift going specifically to improve faculty salaries is being distributed on the following basis: Each of 615 privately supported, regionally accredited liberal arts and science colleges and universities receives a gift about equivalent to its last year's teaching payroll. For ten years only the income from these gifts is to be devoted to raising faculty salaries. After that all the money can be spent in any way the institutions receiving it see fit. There is no requirement that universities having other than liberal arts and science schools limit use of the gifts to improving salaries in these schools alone. They can spread it right through all their faculties if they wish.

In addition to the gift of $210 million specifically directed to increasing faculty salaries, another gift of $50 million goes to a group of 126 institutions selected for specially noteworthy leadership in improving

What's Happened to College Faculty Salaries*



* Real Income before Taxes.

Source: Council for Financial Aid to Education, U. S. Dep't of Commerce: U. S. Dep't of Labor.

the status and pay of teachers. For these schools the individual gifts add about 50% more to the amounts coming from the $210 million fund. They can be used to improve faculty salaries if the institutions choose to do so, but this is not required by the terms of these gifts.

The $210 million plus the $50 million should yield an income of $10-$13 million a year. Even if all this is used to raise salaries, it will be only a small step, however worthy, toward the $200 million per year the colleges need to meet their salary requirements adequately.

Helps Some Who Need It Most

In focussing its gift to improve faculty salaries in privately supported liberal arts and science colleges, the Ford Foundation aims at least part of the help at the spot where it is most desperately needed. Numerous surveys have indicated that the most poorly paid of all college and university faculty members are those in small, privately endowed liberal arts colleges.

But the overshadowing fact is that the teachers in our colleges and universities as a whole are badly underpaid. Just how badly is indicated by the chart above which first appeared in an earlier editorial. (Figures later than those for 1954 are not available.)

The Ford gift will turn the indicator of faculty salaries, which now lies far below the general salary trend, upward a few points. And it will do this in some places where salaries are below the wretched average shown by the chart.

But the Crucial Test Remains

College and university administrators will have the opportunity to extend further the process of getting the help provided by the Ford Foundation gifts where it is most needed. In general, this will mean giving it to senior faculty members, in order to hold experienced teachers and make college teaching attractive as a career. But to make such a division in many schools will take extraordinary fortitude.

The crucial test of the success of the enterprise of the Ford Foundation in raising faculty salaries will lie in whether it prompts the rest of us — college alumni, individuals, business firms and legislators alike — to see that it is a great beginning, not a signal for a recess.

Even with the Ford gifts providing $10-13 million a year, our privately supported colleges and universities must have an increase of about $190 million a year to provide decent faculty salaries.

This is a job far beyond the capacity of the Ford Foundation, imposing though that is. It is a job far beyond the capacities of a few hundred large corporations and a few thousand wealthy individuals. If it is to be done, it is a job at which all of us must work with a will.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

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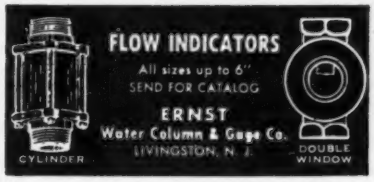

A Good Habit

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Designers selected will design and engineer a variety of the above mentioned facilities as are required by new or existing chemical processes. Work can involve not only economic installations, but also the challenge of meeting special requirements in connection with process problems.

Please send complete resume, including details of education and experience, to:

MR. T. J. DONOVAN
Engineering Department
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POWER PLANT PERSONNEL

A middle east coast utility now constructing a new high pressure, pulverized fuel generating station will accept applications for employment from qualified persons for the following positions, which are available immediately.

Results or Test Engineer

Must be graduate mechanical engineer or equivalent, with experience in modern power plant operation and three years in a responsible supervisory results position. Will be required to assume full charge of power plant testing, chemical control, accounting and research.

Shift Supervisors

To take charge of operation on shift. Must be thoroughly conversant with all phases of modern high pressure, pulverized fuel power plant operation; both electrical and mechanical. Must have previous supervisory experience in power plant operation.

Power Plant Electrical Foreman

Excellent job for a man who has had extensive experience in handling a group of electricians in the maintenance of all electrical equipment in large power plants or substations. Must be able to organize and schedule work and be thoroughly competent to direct trouble shooting on complicated control systems and relaying.

Technician

Graduate Mechanical Engineer. Experience in modern power plant desirable, but not essential. However, applicants must be intelligent and have a real desire to enter modern power plant work. Will assist Results or Test Engineer in the handling of power plant testing, results work and accounting.

Job is located near excellent residential community, good working conditions, forty hour week (paid vacations, insurance, sick pay and retirement plan).

High caliber men are needed to fill the foregoing jobs, and for applicants meeting the above requirements, consideration will be given to reimbursement of expenses incurred for the moving of household goods and personal effects.

All personnel selected will receive training at full pay in order to familiarize themselves with the plant before assuming their duties. Include a complete resume of experience and qualifications in first letter. All applications will be treated confidentially.

P-8978, POWER
330 W. 42 St., New York 36, N. Y.

DO YOU WANT AN ENGINEERING JOB WITH A FUTURE?

THE OHIO VALLEY ELECTRIC CORPORATION, a new Company operating two large steam generating plants in the Ohio Valley has opportunities now for TEST (efficiency), METER, RELAY, and COMMUNICATIONS Engineers. If you have an engineering degree and are interested in a fine opportunity, write:

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Recent graduate in mechanical engineering or one who has majored in physics, to do promotional work for a metals company contacting utilities, consulting engineers and other power field factors. Headquarters New York area. Considerable travel will be necessary. Send full details to

P-8866, POWER
330 W. 42nd St., New York 36, N. Y.

REPLIES (Box No.): Address to office nearest you
CHICAGO: 520 N. Michigan Ave. (11)
NEW YORK: 330 W. 42 St. (36)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

Electrical Engineer—Insurance Company. Must have good working knowledge of repair and maintenance procedures for large generators, motors, transformers, switch gear, etc. Best of group welfare plans, adequate pay and opportunity—must be capable of exercising independent judgement away from supervision. P-9067, Power.

Cooling Tower Company, expanding rapidly, has unusual opportunity for man with some engineering background and with some cooling tower experience. Must be good administrator and organizer, capable of developing quickly into top management responsibility. Replies will be held in strict confidence. P-9020, Power.

Experienced Firemen for spreader stoker fired boilers. Send complete resume to E. M. Mittendorff, University of Virginia Heating Plant, Charlottesville, Virginia.

POSITION WANTED

Senior Electrical Engineer, married no family, age 45. Technical education, 15 years experience in electrical distribution of Public Power Supply Company in Europe. During this period ten years night school teaching experience. 10 years experience with oil companies: a) in South American Refinery and b) in Far Eastern Oilfields. Generation and distribution. Planning and administrative experience and ability. Speaks Spanish, French and German. Desires position as Chief Engineer, assistant to management, etc. Available for personal interview as from 1st March 1956. PW-8274, Power.

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Manufacturers' Representative covering largest power and industrial firms in territory desires equipment lines for Eastern Pennsylvania, Delaware and Southern New Jersey. RA-8601, Power.

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Tennessee Valley Authority needs mechanical engineers for maintenance and engineering staffs of new steam power plants. Interesting assignments in maintaining efficient production from pulverized fuel generating units with capacities up to 250,000 kw; steam pressures to 2000 psig; and steam temperatures to 1050° F. Large-scale operation creates opportunities for pioneering in related equipment fields.

Starting salaries for graduate mechanical engineers are $4340, $4865, and $5750 per year for a 40-hour workweek, with automatic increases for satisfactory service. Vacation, sick leave, and retirement benefits.

Interested candidates should write to

TENNESSEE VALLEY AUTHORITY
Division of Personnel
KNOXVILLE, TENNESSEE

MECHANICAL ENGINEERS

STEAM POWER PLANTS

PROJECT ENGINEERS

Excellent openings for men experienced in the design and engineering of steam electric power plants and power systems. Work will include supervisory duties. Age 35 to 45.

STAFF ENGINEERS

Responsible positions for engineers experienced in heat balance studies, pipe stresses, equipment calculations and preparation of reports required in the design of steam power plants.

These are permanent positions offering opportunity for advancement with an established, recognized firm serving the growing electrical utility industry. Many liberal employee benefits, including pension plan. Please submit resume of education and experience. State age and salary requirements. All replies will be treated confidentially.

J. B. Christerson
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Recent electrical engineering or technical school graduate wanted for interesting laboratory and field investigation assignment with rapidly expanding Boiler and Machinery Insurance Company. Starting salary $390. to $450. per month depending upon qualifications. Attractive new facilities located in suburban Boston. Thirty-six and one quarter hour work week. Send resume to Personnel Manager.

MUTUAL BOILER AND MACHINERY INSURANCE COMPANY
225 Wyman St., Waltham 54, Mass.

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We have an opening for a Power Engineer with 3-4 year's engineering experience to work with one of the largest industrial power plants in the midwest.

Will assist in planning, design and direction of 14 boilers, 18 M.M. lbs. a day steam plant, 15,000 K.W. generating plant and 22,000 K.W. electric distribution system.

Pleasant working conditions. 40 hour week. Liberal employee benefits. Please send details of experience and education to Personnel Department.

A. E. STALEY MFG. CO.
DECATUR, ILLINOIS

MECHANICAL ENGINEER

Graduate mechanical engineer interested in power plant design work. Experience not required.

Excellent opportunity with consulting engineering firm in Middle West. Liberal benefit plans and good working conditions.

Send resume of education and experience with statement of salary requirements to:

P-9004, POWER
520 N. Michigan Ave., Chicago 11, Ill.

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A Career Opportunity with
DU PONT *for an experienced*
POWER ENGINEER

A unique career opportunity for a graduate mechanical engineer is now available in the Engineering Service Division of our Engineering Department. The applicant must have 8 to 10 years of practical power experience, including operation and maintenance of industrial steam power plant facilities and equipment testing. Some experience in steam plant design and construction or in thermal insulation of process piping and equipment is desirable.

The successful applicant will assist in specification of power equipment and in selection of new facilities, and will make economic evaluations and involved heat balances for complicated power systems.

Duties will include determination of causes of equipment malfunctioning and development of recommendations for corrections.

Please send complete resume, including details of education and experience, to:

MR. J. C. COSTELLA, JR.
ENGINEERING DEPARTMENT

E. I. du Pont de Nemours & Co., Inc.
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Ca. 1600 HP Diesel Engine. Fairbanks-Morse or GM preferred.

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GENERAL ELECTRIC TURBO GENERATOR

12,500 KW, 80% PF, 3 phase 60 cycle, 6600 volts, 9-stage, General Electric condensing steam turbine generator unit, 250 PSI, complete with surface condenser and associated equipment. Prompt Shipment.

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Raybestos Manhattan Condor Compensated

TRANSMISSION BELTING

in sizes and specifications we are discontinuing.

All the following are Style "F", raw edges and friction surface

3" x 4 ply 4" x 4 ply 10" x 8 ply

The following Style "H", raw edges, Hycoe surface 12" x 8 ply

Full freight allowed to destination on 200 lbs. or over

For this sale we will consider any order for a full length piece as being a full roll order.

Send us your requirements

THOMAS H. BRADLEY, INC.
Watertown, N. Y.

CHICAGO *Electric Co.*

. . . the right combination of facilities, service and skill to solve your industrial power problems.

We Carry Complete Stocks of

GUARANTEED "REBUILT" EQUIPMENT

WRITE FOR CURRENT STOCK LIST OR PHONE CANAL 6-2900

D. C. MOTORS

HP	MAKE	*230 Volt TYPE	SPD.
250	Westg.	SK-220	450/600
200	Westg.	SK-201	650
200	Cr-Wh.	CM	500
175	G.E.	ELC	750
100	G.E.	MPC	400/800
100	G.E.	RC-34	2500
100	G.E.	RC-19	575
50/120	G.E.	MCF	250/1000
50	G.E.	DLC204	650
50	Cr-Wh.	CMC	700/1100

MOTOR GENERATOR SETS

KW	MAKE	A.C.	D.C.
1000	G.E.	13,200	600
500	Westg.	2300	250
400	Al-Ch.	2300	120/240
400	G.E.	2300	270
300	Westgh.	2300	250
200	G.E.	2300	250/275
200	Westg.	4160/2300	275
200	Ridgway	2300	250
170	G.E.	440	125
150	Al-Ch.	2300	275

SYNCHRONOUS

MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

HP	MAKE	TYPE	PF	SPD
1420	*West.		.7	900
800	G.E.	TS-EL	1.	1200
700	G.E.	TS-EL	.8	1200
600	*G.E.	TS-7640	1.	900
500	*G.E.	TS-7657	1.	514
400	West.	HG	1.	900
300	G.E.	ATI	.8	720
300	*Ideal	SMM	.8	257
250	Al.-Ch.		1.	1200
250	G.E.	ATI	.8	900

SPECIALS!!!

PLATING GENERATOR SETS

AMPS	D.C.	MAKE	A.C.
7500/3750	6/12	Elec. Pdts.	220/440
2000/1000	6/12	Chandy	220
1500/750	6/12	Chandy	220

SPEED REDUCERS

HP	MAKE	MAX SPEED	TYPE & RATIO
250	W.A. Jones	1200	210 SH; 5.63:1
150	W.A. Jones	1200	180 SH; 5.63:1
30	Falk	1750	3012E; 9.394:1

CAPACITORS

22—15 KVAR Cornell Dubilier, type DB-11, 460 v./3 Ph./60 Cy. Indoor dust-tite, fireproof, non-explosive capacitors, complete with indiv. fuses & discharge resistors.

FREQUENCY CHANGERS

KW	MAKE	FREQ	VOLTS
50	G.E.	60/120	440/440
20	Al.-Ch.	60/180	440/330
20	Westgh.	60/120	440/440

SLIP RING

MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

HP	MAKE	TYPE	SPEED
2000	*G.E.	MT	600
1500	*G.E.	MT-30	240
1250	Westg.	CW	600
1200	*Al.-Ch.	ANY	1800
1000	*Westg.	CW	450
700	*Al-Ch.	ANY	720
500	Westg.	CW	350
500	Westgh.	CW	600
400	G.E.	IE-17	900
400	Al-Ch.	3 brg	450
300	*G.E.	IE-15A	1800
250	*G.E.	I-17B	450
200	G.E.	IK-15B	900
200	G.E	IM-17	600

SQUIRREL CAGE

MOTORS

3 phase 60 cycle, 220 or 440 volts (*2300 volts or higher)

HP	MAKE	TYPE	SPEED
1250	*Al-Ch.	ANW	3600
1250	*Al-Ch.	ANW	1200
800	*Westg.	CS	3600
800	*Westg.	CS-1485	1800
700	*Westg.	CS	1200
700	Al-Ch.	AN	900
500	*Al-Ch.	6316-SW	1800
500	G.E.	KT-424	450
500	*G.E.	KT569S	900
350	G.E.	KT-424	360
350	Ideal	A	1800
300	*G.E.	K-6344Y	1200
300	G.E.	K-6353 TEFC	720
250	*L-Allis	OGK-148	720
250	*G.E.	IK	600
250	G.E.	IK-17A	600

CHICAGO *Electric Co.* 1320 WEST CERMAK RD, CHICAGO 8, ILL.

3 G. M. 200 KW DIESEL GENERATOR SETS

Reconditioned by U.S. Navy

EQUAL TO NEW

Complete with motor driven starting air compressors, air tanks, dead front type generator switch panels and all other necessary accessories.

ENGINES

G.M. Model 8-268A—6½x7—1200 RPM—air starting—complete with engine operating panels, heat exchangers, cooling pumps, filters, strainers, governors, pyrometers, etc.

GENERATORS

Westinghouse 200 KW 250 KVA—440/3/60—1200 RPM—80% P.F.—continuous—drip-proof enclosure—direct connected exciter.

SIZE AND WEIGHT

Each unit, mounted on a pre-fab sub-base, is 13' 0 5/16" long, 3' 10½" wide, approx. 8' high. Weight of engine and generator only 17,705 lbs. Each unit, with all accessories, about 27,000 lbs.

CONDITION

No expense has been spared to put these 3 units in "equal to new" condition. Don't miss this opportunity to buy! Inspection can be made at our warehouse, Curtis Bay, Baltimore.

THE BOSTON METALS CO.
313 E. BALTIMORE STREET
BALTIMORE 2, MD CURTIS 7-5050

PUMPS

2—24"x24" Dayton Dowd Centrifugal, 18,000 GPM, at 35' Hd.
1—5"x10" McGowan Hydraulic, 185 GPM, 500 PSI, #30005
1—3½"x10" Worthington Hydraulic, Type D1654, 85 GPM, 500 PSI, #978859

TRANSFORMERS

100—1½ KVA, Line Material, Dry type, 120/240/480 volt primary 120/240 volt secondary with taps, 1 phase, 60 cycle
3—250 KVA, General Electric, OISC, 2300 volt primary, 460/230/115 volt secondary, 1 phase, 60 cycle.
6—500 KVA, Westinghouse, OISC, 2300 volt primary, 460/230 volt secondary, 1 phase, 60 cycle.

COMPRESSORS

4—Nash-Hytor Size H5.

GASOLINE POWER UNITS

6—53 HP, NEW, Chrysler Industrial, Model 7A-458, base mounted, complete with controls including four-speed transmission.

BENSON-WILIMZIG, INC.
1704 North 8th St. St. Louis 6, Mo.
Phone GArfield 1-4290

200 HP, 125# Scotch Marine Boiler, oil fired
30 HP good for 200# Pressure E. C. Boiler
250 HP, 150# Pressure HRT Boilers—Unused
175 HP "VL" Erie City, 160# Pressure Boiler
500' Sections of 42" Wide Belt Conveyors
3—10,000 Gal. Tank-Car Storage Tanks, Tested
169'x80' & 380'x40' Steel Buildings
6'x35' Grain Dryer—like new—1950

H. & P., 6719 Etzel, St. Louis 14, Mo.

FOR SALE
18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

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LIDGERWOOD HOIST

Serial #8001. 250 H.P. 2300 volt slip ring motor drive Hoist designed for 350 f.p.m. of 1⅜" rope. Face of drum 55-9/16", diameter to bottom of groves, 84" Electric brake connected. Split drum, all steel base, Blue prints available.

2000 KVA G.E. type H. T. Form D.H. 66,000/22000/2300/60 cycle. Serial #4540898.

ELJAY INC.
L. J. LAND, Pres.
401 Broadway, New York 13, N.Y.
Telephone WOrth 6-0969

—TRANSFORMERS—
BOUGHT AND SOLD

We carry a large stock of rebuilt and guaranteed transformers, and invite your inquiries.

Custom-built transformers and coils manufactured to your specifications.

Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned. Ask for our price schedule.

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5318 Hetzel St. **Cincinnati 27, Ohio**

40 Years' Dependable Service

DIESEL UNITS

1250 KVA and 375 KVA—General Motors
438 KVA (2) Diesels, also 3—187 KVA
250 KVA & 187 KVA Chicago Pneumatic
62 KVA (2) International; mobile.

TURBO UNITS

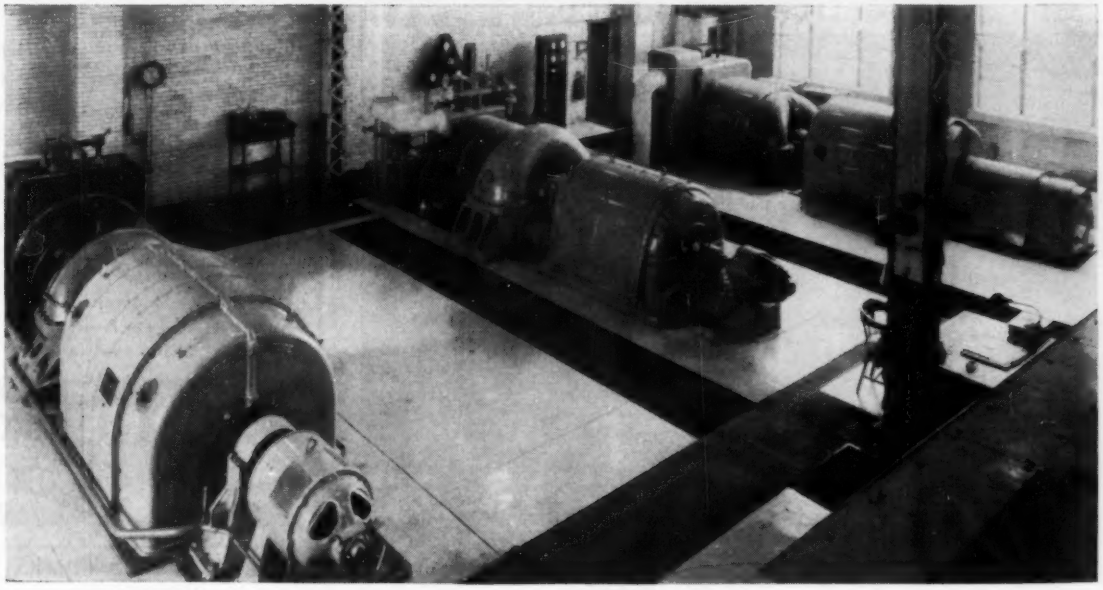
1250 KVA Elliott, non. con.-bleeder, 325#-145# bleeder; & 5# bp
250 KVA Murray, 400#; 30/110# exhaust.
250 KVA Murray 100/150#; 0/15# bp
1250, 937, 625 & 125 KVA, General Electric

BOILERS:

250 to 1250 HP, mostly B&W

POWER PLANT EQUIPMENT CO., Inc.
234 Willets Ave., West Hempstead, N. Y.

3750 KVA, 2500 KVA, Westinghouse & 1563 KVA G. E. Turbine-Generators



Above Turbine-Generators are all 400# PSIG, 750 Degrees FTT 3/60/2300 V., equipped with 2-pass Surface Condensers, direct-connected Exciters, complete with all parts and fittings. Serial Number of Westinghouse Turbine, 3750 KVA, is #5-A-3107-1, new 1949. Other units rebuilt and pressures changed to 400# PSIG in 1948. All units are in good operating condition; just came out of service 30 days ago and are still on foundations.

ABOVE IS THE SWITCHBOARD SERVING THESE UNITS

We own above equipment outright. Will sell it complete, as shown, or will sell each unit separately.

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19701 JAMES COUZENS HIGHWAY
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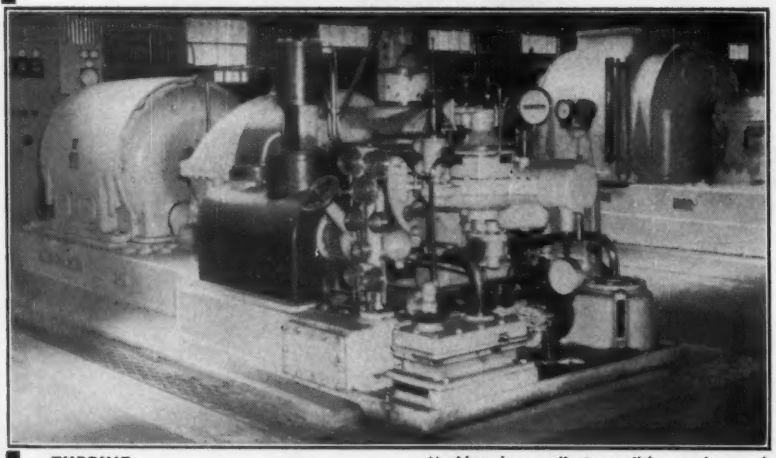
BROADWAY
3-1901

TWO TURBO-GENERATING UNITS, ALLIS-CHALMERS TURBINES

GALLUP, NEW MEXICO



TURBINE:
1—1000 K.W. at 80% P.F., 1250 K.V.A. Condensing Turbine Generator.
200 P.S.I.G. and 550° F. at Throttle.
Generator for 2300 Volts 3 P-60 Cycle at 3600 R.P.M. (314 Amperes).
Continuous 100% load, Stator 60° c. Rotor 95° c. excitation 125 V., 80 Amperes at rated load. Built 1940.

CONDENSER:
Worthington Surface Condenser, 4500 sq. ft. Surface complete with Condensate and Air Pump and Drives.

STRUCTURAL STEEL:
Complete structural steel support for Turbine Generator and Condenser.
No concrete Turbine foundation required; except pad for supporting steel.

Machine in excellent condition and can be demonstrated in Gallup, New Mexico, Municipal Power Plant. Serial Number 108481.

TURBINE:
1—1500 K.W. Allis-Chalmers Turbine Generating Unit, 2300 Volt, 3-P-60 Cycle at 3600 R.P.M. (471 Amperes).
Continuous 100% load, Stator 60° c, Rotor 95° c. 200 P.S.I.G. and 550° F. Steam to throttle.

CONDENSER:
This Unit is equipped with two C. H. Wheeler Condensers, Condensate and Air Pump.

STRUCTURAL STEEL:
Complete structural steel support for Turbine Generator and Condenser.
No Concrete Turbine foundation required; except pad for supporting steel.

Machine in excellent condition and can be demonstrated in Gallup, New Mexico, Municipal Power Plant.

Both of these machines are in excellent top condition and can be started up and run under actual load conditions for any prospective customer.

We could remove these machines and make them available during March or April of 1956.

THE J. F. WHITE ENGINEERING CORP.
4390 South Santa Fe Drive — Englewood, Colo.
Phone: SUnset 1-7829, 1-7820

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2 Barrett Haentjens Acid Resisting Pumps, 1 Stainless Steel, 1 Bronze.

300 GPM 575 Ft. Head Direct Connected on a common cast iron base to 75 HP 3 phase, 60 cycle, 440 Volt, 1800 RPM KT motors. Price $1000 Each

ELJAY, INC.
401 Broadway, New York 13, N. Y.

1—2500 KVA—GE Curtiss Turbo Generator 3-60-2300V—3600 RPM, 15-B-2 4 stage turbine condenser
1—18" Worthington Cent. Pump LCS-2—2 stage—270' head, 12140 GPM, 1000 HP G.E. Syn. motor, 3-60-2300V
1—20" Worthington Cent. Pump, 12140 GPM—49' head

HARRIS MACHINERY COMPANY
501 30th Avenue S. E., Mpls., Minn.

SWITCHGEAR

OUTDOOR
600 ampere GE FLO-15-100-14.4 KVA—100 MVA, auto reclosing, 2300 V.
400 ampere, West. 0221-37000 V with PT & CTs, 26.4 KV.

INDOOR
GE Metal Clad Oil Circuit Breakers with meters & disconnect switches.
2—1200 amp, FK44B—15 KV—100,000 KVA I.C.—2300 V.
1—200 amp, FK143—Elec. Oper., 440 V—50,000 KVA, I.C.
6—1200 amp, FK143—440 V. 50,000 KVA, I.C.
3— 600 amp, FK42—440 V.—25,000 KVA I.C.

INTERRUPTIVE SWITCHES
400 amp, ITE, type LI-5KU-60 KV BTL #39218.
400 amp, West., type LCV-15 KVA BIL-95 KVA—PW, style #1491183.

Motor Generator Set Headquarters
Any Voltage or Frequency
Please Send Us Your Inquiries

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L. J. LAND INC.
148 GRAND STREET
NEW YORK 13, N. Y.
Est. 1910 — 44th YEAR

BOILER FEED PUMPS

STEAM TURBINE DRIVEN

GPM	TFH	Stage	Mfg.
450	892	4	Worth. (2)
500	850	4	Worth.
200	1375	6	Ingersoll R. (2)
200	850	2	Weinman (2)
190	1320	4	De Laval
750	725	4	Worth. (2)

MOTOR DRIVEN

GPM	TFH	Stage	Mfg.
740	2250	5	Worth.
700	1550	6	Worth.
675	1100	5	LeCourtenay
500	1050	5	Worth. (3)
100	1150	5	Gould

UNDERWRITERS FIRE PUMP

GPM	TFH	Stage	Mfg.
1500	231	1 (motor driven)	Fairbanks
750	231	(gas. driven)	Allis Chal. (2)

MOTOR DRIVEN SAND PUMPS
American Manganese 10"
Allen-Shaffer-Hoff 14"

NASH HYTOR COMPRESSORS
(4) size #2, 850 R.P.M., 10# pressure, 240 C.F.M.; 860 R.P.M., 180 C.F.M., when used as a Vacuum Pump.

2—2800 Gal. cap. 100# steam press. hot water storage heaters, mfg. by Quaker City Iron Works. Good shape.

This is only a partial listing of pumps carried in stock. We have hundreds of other pumps, compressors, and power equipment. Don't ask us what we have, write and tell us what you want.

PHILADELPHIA TRANSFORMER CO.
Box 566 — Dalton, Pa.

3000 KW MODERN Westinghouse Turbine-Generator COMPLETE

NEW 1949: Installed 1950: Very High Grade Unit
Steam 400# psig., 750° FTT, 3/60/2300-V.
Surface Condenser, All Auxiliaries, Switchboard

Send for Complete Data

CHARLES WEAVER
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DIESEL GENERATOR SETS

3—1500 HP General Motors Model 16-576, 720 RPM, 1000 KW Elliott 3/60/2400 V generator. Like new.

1—720 HP Fairbanks Morse Model 33, 5 cyl. 257 RPM, 580 KVA F-M 3/60/2400 V generator.

1—560 HP Fairbanks Morse Model 33, 4 cyl. 257 RPM, 470 KVA F-M 3/60/2400 V generator.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. — St. Louis 1, Mo.

BELYEA RE-NU-BILT

LARGE ELEC. POWER EQUIPMENT

SELECTED STOCK ITEMS

RE-NU-BUILT—GUARANTEED—RE-NU-BILT
COMBINATION MILL DRIVES — 15/2500 HP
D.C. MOTORS WITH M.G. SETS & CONTROLS

	MAKE	TYPE	VOLTS	R.P.M.
2200 HP	G.E.	MCF-12	600	400/500
2000 KW	G.E.	Syn.	2300/4600	514
1250 HP	Whse.	Rev.	600	300/600
1000 KW	G.E.	Syn.	2300/4600	720
1250 HP	G.E.	MCF	600	750/900
1000 KW	G.E.	Syn.	2300/4600	720
1000 HP	G.E.	MCF-8	600	250/700
1000 KW	G.E.	Syn.	2300/4160	720
350 HP	Whse.	Mill	250	325/650
300 KW	Whse.	Syn.	220/440	1200
200 HP	G.E.	CD-1650Z	250	500/1500
200 KW	Whs.	Syn.	440	1200

ALSO MANY OTHER COMBINATIONS

A. C. MOTORS—3Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
1	1500	G.E.	MT-498	2300	360
1	1100	G.E.	IM	2300	720
1	1000	A.C.	Mill	2300	240
1	750	G.E.	MT-573	2200	1199
1	700	Al. Ch.	D.P.	2300	500
1	500	Whse.	CW	550	350
1	500	G.E.	M-569Z	2200	1180
1	400	Whse.	CW-960A	440	1170
1	400	Whse.	CW	440	514
1	400	Whse.	CW-1218	2200	435
1	350	G.E.	IM-17A	440/2200	720
1	350	G.E.	MT-442Y	2200/4000	253
1	200	G.E.	IM	2200	580

SQUIRREL CAGE

1	800	G.E.	KT-573	2300	1180
2	450	G.E.	FT-559BY	440	3570
1	500	G.E.	K-6345B	2300	1185
2	450	Whse.	CS-1420	2300/4158	854
1	400	G.E.	1E-15B	2300	1145
1	400	G.E.	IK	2200	500
1	200	G.E.	IK-17	440	580
3	200	G.E.	KT-557	440	1800
1	150	Whse.	CS	440	580

SYNCHRONOUS

1	4350	C.W.	2501-SL	13800/6900	514
2	1750	G.E.	ATI	2300	3600
3	2000	Whse.		2300	120
2	735	G.E.	ATI	2300/12000	600
1	500	Ideal	SM	2300/4160	1800
2	500	G.E.	TS-7567	2200	1200
1	450	Whse.		2300	450
1	400	G.E.	TS	2300	400

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2000/2400	G.E.	450	250/300	2300/4600
1	2000	G.E.	500 25cy	660	11000
2	2000	G.E.	514	600	6600/13200
1	1750/2100	G.E.	514	250/300	4800/2400
1	1500	G.E.	720	600	6600/13200
1	1000	G.E.	900	260	6600
1	750	Whse.	900	250	2300/4150
1	750	G.E.	900	125/250	2200
1	600	G.E.	720	250	440/2300
1	300	Whse.	1200	250	440/2300
1	250	A.C.	900	125	2300/4000
1	200	Whse.	1200	250	220/440
1	150	Whse.	1200	600	2300
1	150	Whse.	1200	275	2300

SIX 1200 KW RECTIFIERS

Whse., D.C. output, 2000 Amp., 283/600 volts, with 1328 KVA, 3 ph., 60 cy., Transf., 11,000 volts and controls. Can furnish for other voltages.

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltages
1	2500	A.C.	OA	3	6900/11900x2400/4160Y
3	333	G.E.	HS	1	7200x2400/4160Y
3	333	G.E.	HSWR	1	2300/4000x230/460
3	333	G.E.	HD	1	13200x2530x4350Y
3	250	Penn	OISC	1	34500x120/240
3	200	Whse.	OISC	1	13200x120/240

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltages
1	12500	Whse.	60/25	13200/13200
1	5000	G.E.	60/50/60	6600/11000/6600
2	2500	G.E.	25/62.5	2300/2300
1	1000	G.E.	25/58.3	4400/2300
1	500	Al. Ch.	2580	11000/2300

TURBO GENERATORS

Qu.	KW	Make	Does.
1	4000	G.E.	Condensing 425 — 750 F.T.T. Surface Condenser 3/60/2300/4000 V Direct conn exciter.
1	1500	Whse.	Auto. extraction 190 lbs.—600° F.T.T. 60 lb. extraction 3/60/240 V. Div. conn. Exc.
1	1000	Moore	Auto-Ext. Cond. 175/200# I.S.P. 5/30# G. Ext. Surface Condenser—3/60/2300.
1	1000	G.E.	Non-condensing 175/200 lbs. I.S.P. 5/30 lbs. G.S.P., 480/3/60.

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43 Howell St., Jersey City 6, N. J.

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"Certified Rebuilt" Motors and Generators

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
150	Whse.	SK-201	230	200/900
150	Whse.	SK-184	230	850
100	Whse.	SK-173	230	850
100	Reliance	651T	550	1000/1600
100	Reliance	651-T	230	575/1150
75	Whse.	SK-180	230	475/900
75	Cr. Wh. TEFC	53H	230	850
75	F. Morse b.b.	DH-140	115	1600
50	G.E. dynam. (4)	TLC25	250	1000/3500
50	Whse.	SK-150	230	750
40	Reliance b.b.	131-T	550	1750
40	Whse. (2)	SK-133	230	850
35	Gen. Elec.	BF-14	230	250/1000
30	Imperial b.b.	D69	230	400/1600
30	Star b.b. (2)	8B	230	1750
25	L. A. TEFC	RNA	230	850

200 KW M-G SET—LIKE NEW
Whse. DC 250 V. gen. w/synch. motor. 3/60/220/440 V., incl. AC & DC control. Quick shipment, low cost, guaranteed.

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V.
500	Gen. Elec.*	2300/4000 AC	600 DC
200	El. Machy.*	2200/440 AC	250 DC
200	Whse.*	220/440 AC	55 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Whse.*	220/440 AC	250 DC
150	Gen. Elec.	220/440 AC	125 DC
150	Whse.	2200/440 AC	275 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	G.E.*	2200/440 AC	125 DC
100	Whse.	220/440 AC	250 DC
75	Cr. Wheeler	25 cycle	125 DC
75	Cr. Wh. b.b.	220/440 AC	250 DC
75	Whse.	2200/440 AC	600 DC
60	Gen. Elec.*	220/440 AC	60 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Whse.	220/440 AC	250 DC
40	Whse. (2)	220/440 AC	250 DC
30	Gen. Elec. (2)	220/440 AC	125 DC
30	F. Morse b.b.	220/440 AC	24 DC
30	Allis Ch.	220/440 AC	250 DC
25	Whse.	220/440 AC	125 DC
20	Rel. b.b. (2)	220/440 AC	250 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
150	Whse. b.b.	SK-163L	250	1800
150	Whse.	SK-184	250	1150
105	Century b.b.	1500 amp.	70	1200
100	Whse.	SK-173	250	1150
100	Allis Ch.	K	125	1200
100	Reliance	651T	600	1200
75	F.M. b.b.	DG	125	1800
75	Cr. Wh. bb (2)	CCD	250	1150
75	Whse. b.b.	SK-163	125	1000
75	Whse.	SK	250	600
60	Gen. Elec.	CD	250	1500
50	Whse.	SK-150	250	1000
40	Whse.	SK-133	250	1150
25	G.E. b.b. (10)	CD85	250	2300
25	Whse.	SK93	125	1750

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
700	G.E.	Synch.	2200	514
700	Allis Ch.	Sq. Cage	440	900
700	G.E.	Synch.	2200/440	1200
600	G.E.	Slipring	2300	600
600	G.E.	Synch.	2200	327
500	G.E.	Sq. Cage	2200	3600
500	G.E.	Sq. Cage	4000	1800
450	Allis Ch.	Synch.	480	400
400	G.E.	Slipring	2200	900
400	Whse.	Sq. Cage	2200	514
400	G.E.	Synch.	440	450
300	Whse.	Synch.	440	1200
300	Gen. Elec.	Slipring	220/440	1200
300	El. Machy	Synch.	220/440	360
300	Al. Ch.	Sq. Cage	2200/440	720
300	G.E.	Slipring	440	360
250	Gen. Elec.	Sq. Cage	440	3600
250	Whse. X-P	Sq. Cage	2200	3600
250	Burke	Synch.	220/440	360
250	G.E.	Slipring	220/440	720
250	G.E.	Sq. Cage	220/440	900
250	Gen. Elec.	Synch.	220/440	450
250	G.E.	Synch.	220/440	720
250	L.A. (2)	Sq. Cage	2200	1800
225	G.E.	Synch.	220/440	900
200	Gen. Elec.	Sq. Cage	220/440	1200
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	2200/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	E. M.	Synch.	220/440	1200
175	G.E. (2)	Synch.	220/440	720
150	El. Machy.	Synch.	220/440	360
150	Allis Ch. (2)	Slipring	220/440	1200
150	Allis Ch.	Slipring	2200/440	720
150	G.E. (2)	Sq. Cage	2200/440	720
150	Allis Ch.	Sq. Cage	440	450
150	G.E. vertical	Slipring	4000/2300	1200
125	Gen. Elec.	Slipring	440	600
125	G.E.	Slipring	220/440	720
125	G.E. TEFC	Sq. Cage	220/440	3600
125	Whse.	Sq. Cage	220/440	900
125	Rel. TEFC	Sq. Cage	220/440	1800
125	G.E.	Slipring	220/440	450
125	G.E. b.b.	Sq. Cage	2200/440	1200
100	L. Allis b.b.	Sq. Cage	440	3600
100	Ideal	Sq. Cage	2200	1800
100	G.E.	Slipring	220/440	720
100	G.E.	Slipring	220/440	514

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn cond		4000/2300	900
790	Gen. Elec.	ATI	2300/480	1200
485	Allis Ch.	1 brg.	480	400
275	G. E. 25 cycle	ATI	480	750
225	El. Machy.		480	720
225	Gen. Elec.	ATI	240/480	900
156	El. Machy		240/480	900
156	Whse.	C	240/480	1200
150	Whse.		2300/480	600
75	El. Machy.		2300	900
56	G.E.	ATB	240/480	1200
37½	Whse.		240/480	1200

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2—UNITS—250 KW—600 VOLT—20 FT. HD.
1—UNIT—500 KW—2300 VOLT—28 FT. HD.
1—UNIT—500 KW—2300 VOLT—36 FT. HD.
All units good condition complete with switchgear can be delivered loaded in R.R. cars at $25.00 per KW or less. For complete information.

SORENSON GOVERNOR SERVICE
264 KOSSUTH ST., BRIDGEPORT, CONN.

Locomotives, diesel, 20 to 100 tons, (9).
Cranes, locomotive, diesel, 35 & 25 tons.
3000 KW G.M. diesel elec. generator plant.
1200 KW Chicago Pneumatic diesel generator.
1000 KW General Motors diesel generator.
Nordberg 1000 HP 700 KW D.C. generator set.

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3000 KW MODERN POWER PLANT—COMPLETE

NEW 1949 — **LITTLE USED**

3000 KW Turbo generator, Allis Chalmers 3600 RPM 3/60/2300/4600 Volts 400# 600° FTT cond. 28" Vac.

50000 lbs/hr Boiler, Union Iron Works, 450 psi incl. stokers with traveling grates

WITH ALL AUXILIARIES

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Rebuilt HEMPHILL Guaranteed EQUIPMENT

TRANSFORMERS 60 CYCLE

Qu	KVA	Make	Type	PH.	Voltages
1	750	G.E.	HT	3	4150x120/240
2	750	G.E.	H	1	4600x120/240
2	400	Pitts.	OISC	1	4150x240/480
2	333	West.	S	1	4150-240/480
2	300	G.E.	H	1	13200-110/220
3	50	G.E.	H	1	2400/4800-120/240
1	25	G.E.	Pyranol	1	2400/4160-120/240
3	200	G.E.	H	1	7800/15600-440/220
3	150	Amer.	OISC	1	2400/4160-240/480

SYNCHRONOUS MOTORS

QU	HP	Make	Speed	Type	Volts
1	1400	G.E.	514	ATI	4150
1	1000	Whse.	225	Mill	2300/4150
1	1000	West.	360	Mill	2300/4150
1	500	Whse.	450	HR	2300
1	300	EM	720	TEFC	2300
1	300	G.E.	600	ATI	220/440/2400
1	200	Whse.	600	ATI	240
1	150	G.E.	1800	TS	220
2	150	Allis	360		2200
1	125	G.E.	600	TS	2200
1	125	EM	900		4800
1	100	G.E.	900	TS	2200

SLIP RING MOTORS

QU	HP	Make	Speed	Type	Volts
1	500	G.E.	1200	M	2400/4150
1	400	Whse.	450	CW	450
1	250	Whse.	600	CW	440
1	200	Whse.	600	CW	440
3	150	A.C.	1800	AY RW	2300
1	100	G.E.	1800	IM	220
1	75	G.E.	600	IM	440
1	60	G.E.	1809	MT	220
1	200	Whse.	500	CW	440

SQUIRREL CAGE 60 CYCLE

Qu.	HP	Make	Type	Speed	Volts
1	200	West.	C.S. Exp Proof	1800	220/440
2	250	G.E.	K.F. TEFC	1800	2300
1	150	G.E.	KT-502	600	440
1	100	West.	CS	1200	440

MOTOR GENERATOR SETS

QU	KW	Make	Speed	DC	AC
1	1000	G.E.	514	600	2300/4150 syn
1	1000	Whse.	720	600	2300/4150 syn
1	1000	Whse.	720	275	2300/4150 syn
1	300	G.E.	1200	250	2300/4150 SR
1	150	C.W.	600	125	220/440
1	97	G.E.	1200	60	4150 Syn
1	75	G.E.	1800	250	220/440 SC
1	60	Whse.	1200	66	2200V
3	60	EM	1200	125	220
1	30	Whse.SK	1750	250	2300/4150 Syn
1	20	EM	1800	125	220 V
2	30	G.E.	1800	125	220/440 V

DC, 230 VOLT MOTORS

Qu	HP	Make	Speed	Type
2	150	C.W.	900	WP
1	125	G.E.	1700	RC
2	75	C.W.	900	WP
3	30	C.W.	700	CM
1	35	G.E.	860	R
1	25	Whse.	835	SK
1	30	G.E.	1650/1800	CDM85

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15— 50 Kva GE 33000-2400 New
120— 25 Kva GE 33000-2400 New

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SPECIAL—2 new Combustion Engine type VU Watertube Boilers—35,000# pr hr. 425 PSIG.

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BOILERS—5—40,000# per hr. B. & W. 230# W.P. Vertical Steel Sectional Header.

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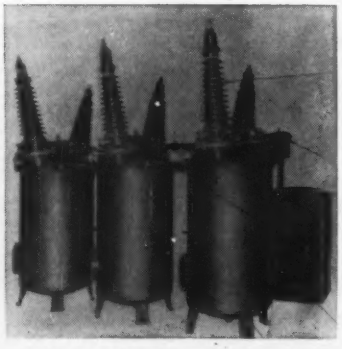

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*1—G.E. FHKO-136-2046BS, 400 ampere

37KV, 500,000KVA, solenoid operated
*7—West. O-221, 400 ampere

15KV, 750,000KVA, motor operated
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Maximum pressure 20 lbs.—220,000 lbs. per hour—1800 gallons storage volume.

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World's Best Rebuilts

15 CFM 1000 psi I.R.
21 CFM 800 psi Curtis
25 CFM 2000 psi I.R.
48 CFM 3500 psi I.R.
95 CFM 1500 psi C.P.
124 CFM 40 psi Fuller
137 CFM 100 psi I.R. ES
211 CFM 100 psi I.R. ES
230 CFM 1500 psi I.R. ES3
273 CFM 15 psi Wor-HB
283 CFM 35 psi I.R. ES
320 CFM 125 psi I.R. ES
368 CFM 100 psi I.R. ER
400 CFM 100 psi I.R. XRB
464 CFM 100 psi I.R. ES
552 CFM 100 psi I.R. XRB
676 CFM 125 psi I.R. XRB
877 CFM 125 psi I.R. XRB
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3—2160 KW BUSCH-SULZER DIESEL GENERATOR SETS, 3/60/4160/2300, complete. New 1942. Can be seen operating.

1—1500 KW MG Set, 250 volts DC, 2300/4600/3/60.

1—200 KW MG Set, 250 volts DC, 2300/3/60.

1—200/245 HP, 250 volts MILL MOTOR, 600/700 RPM.

1—6000 GPM DEEP WELL PUMP, 80' head.

4—300 HP KEWANEE BOILERS, 125 PSI. NEW 1942.

2—150 HP UNION WATER TUBE BOILERS, 160 PSI.

1—250 HP STIRLING BOILER, 150 PSI.

3—4' x 135' STEEL STACKS, welded.

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6—100 KVA 60 cy. 1 ph. O.I.S.C. Transformers 2400-120/240.

6—75 KVA 60 cy. 1 ph. O.I.S.C. Transformers 2400-120/240.

9—37½ KVA 60 cy. 1 ph. O.I.S.C. Transformers 2400-120/240.

19—15 KVA 60 cy. 1 ph. Dry Type 240/480—120/240.

15—25 KVA 60 cy. 1 ph. Dry Type 240/480—120/240

8—37½ KVA 60 cy. 1 ph. Dry Type 240/480—120/240.

3—50 KVA 60 cy. 1 ph. Dry Type 240/480—120/240.

3—10 KVA 60 cy. 3 ph. Dry Type 480—208Y/120.

2—37½ KVA 60 cy. 3 ph. Dry Type 480—208Y/120.

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BRAND NEW—IN ORIGINAL CASES

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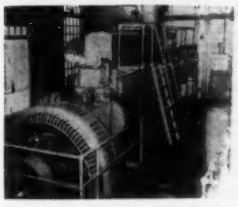

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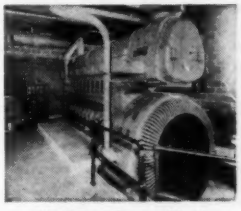

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H.P.	Volts	Make		Speed
500	2200	G.E.		450
450	440	Whse.		514
400	4000/2300	Whse.		450
400(2)	2300	G.E.		900
300	2200/440	G.E.		720
300	440	G.E.	(hoist)	600
300	2200	G.E.		360
300	440	Whse.		3600
250	2200/440	G.E.		1200
250	440/220	Whse.		600
250	550/440	G.E.		1200
225	4000/2300	G.E.	(hoist)	600
200	440/220	Whse.		514
150(2)	440/220	G.E.		720
150	2200/440	G.E.		600
125	550/440	G.E.		1200
125	2200	G.E.		600

SYNCHRONOUS MOTORS 3-Ph 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G.E.	ATI	720
375	2200	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/400	G.E.	TS	720
300	2200/440	G.E.	TS	1200
250	2200/440	G.E.	TS	720
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G.E.	FT	3600
500	2200/4000	Elliot	SC	1800
400	2300/4000	Whse.	CS	720
400	2300/4000	G.E.	K	1800
350	440	G.E	KT	1200
300	2300/4000	L. Allis	PS	1800
250	2300	Whse.	CS	600
250	2300	G.E.	K	900
225(2)	2200/440	G.E.	KT	1200
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	JK	600
200	2200	G.E.	KT	1800
150	2200	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440/220	G.E.	KT	720
150	2300/440		KT	600

A. C. GENERATORS

1—320 kva, 660 rpm 2300/440/220 V., G.E.
1—300 kva, 900 rpm, 2200 V., Whse.
1—225 kva 60 rpm, 220/440 V., G.E.
1—200 kva, 720 rpm 2200/440 V., G.E. (Ball)
1—187 kva, 1200 rpm, 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-25, 600 amp., 15,000 V. G.E.
1—400 Amp., Condit, 3P., 25 KV outdoor
1—400 Amp., R. Smith, 3P, 7.5 KV outdoor

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	2870
150	230	El. Dyn.	B/brg.	800
150	230	Whse.	SK	1750

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
200	G.E.	440/220	Syn.	250
175	G.E.	220/440	Syn.	230
125	G.E.	4000/440	Syn.	125
125	G.E.	440/220	Syn.	250/125
100	Al. Ch.	220/440	Sq. Ca.	240/120
65	G.E.	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—1000 kva, Whse., 13,800—2300 V., 3 ph., New
1—600 kva, Standard, 13,800—2300 V., 3 ph.
3—500 kva, Whse., 66000—2300 V.
3—333 kva, G.E., 22000/11500—2300 V.
3—333 kva, Mol., 13,800—2300 V.
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2—300 kva, G.E., 4150—240 V., 3 ph., Pyr.
3—200 kva, Mol., 13,800—2300 V.
3—200 kva, G.E., 2300—575 V.
3—100 kva, Al. Ch., 2400—480/240 V.

only partial listing

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HARRY J. RICE, Pres.

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Dangerous gusts of scalding steam made safe

A typical example of B. F. Goodrich improvement in rubber

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INDUSTRIAL PRODUCTS DIVISION

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Grinnell designs, manufactures, and distributes a complete line of pipe hangers and supports for every piping requirement. Grinnell maintains an experienced staff of engineers in the field — ready to assist you on the job with any piping problem.

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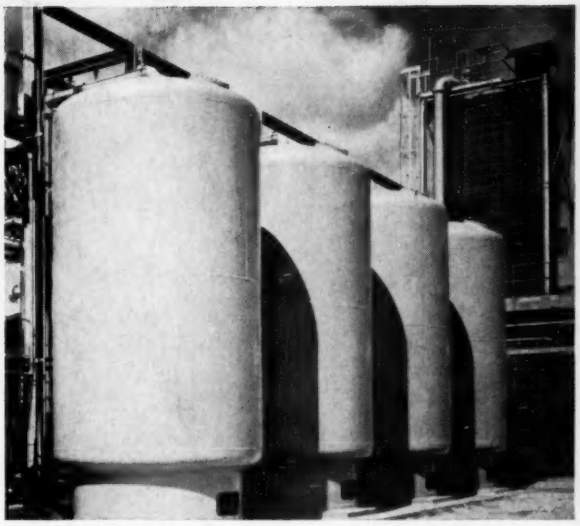
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

ENGINEERING. Permutit engineers work with your staff or your consulting engineers to design all or any part of your water conditioning system.



EQUIPMENT. Permutit supplies complete equipment. Critical parts such as valves, chemical feeders and controls are designed and made by Permutit.

How Permutit® Solves a Water Problem

U. S. industry is faced with using lower grade water. Results: possible boiler scale, turbine deposits, corrosion of pumps and piping . . . also stains, blisters and other problems in plating, rinsing, dyeing and chemical processing.

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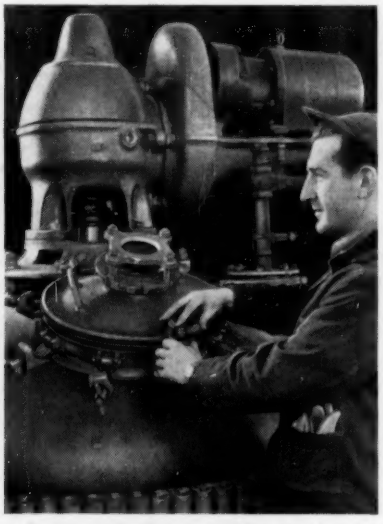
• **Complete proposal** by Permutit engineers covers type, size and capacity of equipment, price, any special engineering services and performance guarantees.

• **Manufacturing** – After the proposal is accepted, Permutit designs the entire project, schedules assembly and shipping. Critical parts, ion exchange resins, control panels are all made in Permutit plants. (No other U. S. firm makes all these components.)

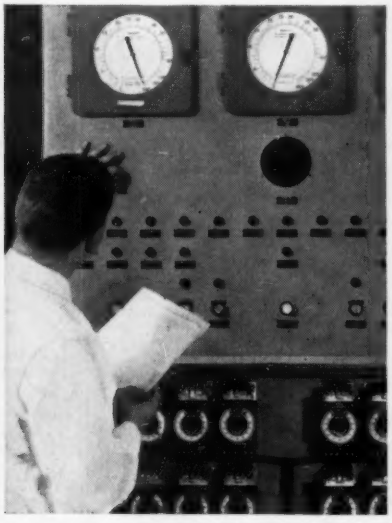
• **Test runs** – Where required, Permutit checks the installation, supervises start-up and initial operation, trains permanent operating personnel.

• **For further information** look up the Permutit office in your city or write to The Permutit Company, Dept. P-2, 330 West 42nd St., New York 36, N. Y.

WATER ANALYSIS. Permutit's modern water-analysis laboratory tests over 1200 samples a month!



ION EXCHANGE RESINS. Permutit makes its own ion exchange resins, natural and synthetic zeolites.



AUTOMATIC CONTROLS to ensure optimum results are designed, assembled, wired and tested by Permutit.